Massachusetts Bay Transportation Authority

Mitt Romney, *Governor* | *Kerry Healey*, *Lt. Governor* | *John Cogliano*, *Secretary and MBTA Chairman* | *Michael H. Mulhern*, *General Manager*

May 13, 2005

Mary Beth Mello, Deputy Regional Administrator
Federal Transit Administration – Region I
The Volpe Center
55 Broadway
Cambridge, MA 02142

Ellen Roy Herzfelder, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street, 9th Floor
Boston, MA 02114

Re: Silver Line Supplemental Draft Environmental Impact Statement/ Supplemental Environmental Impact Report EOEA # 6826 and EOEA #11707

Dear Ms. Mello and Secretary Herzfelder:

The MBTA is pleased to submit for your review the attached environmental review document for Phase III of the Silver Line.[1] This project involves construction of a tunnel system between South Station and Washington Street, connecting Phase I of the Silver Line (currently in operation along Washington Street) with Phase II (serving the South Boston Waterfront which opened late last year). The MBTA has identified a core tunnel segment for Silver Line Phase III that follows an alignment along Essex and Boylston Streets with two new Silver Line stations at Boylston Street and Chinatown, and it is considering alternative routes for the tunnel connection to the portal that will link to the Washington Street service.

The Silver Line has had a long history in the state and federal environmental review processes. The project is actually the merger of two separate MEPA filings (one for the South Boston Transitway, EOEA #6826, and one for Washington Street Replacement Service, EOEA #11707) that were once independent projects. In a Notice of Project Change (NPC) in 1998, the MBTA linked these two projects to create the Silver Line project.

The original proposal for Phase II of the Transitway (from South Station to Boylston) proposed an alignment going from South Station along Essex and Avery Streets, and terminating in a loop underneath the Boston Common's Central Burial Ground. The impacts of that alignment were fully reviewed under MEPA and NEPA. The FEIR/FEIS for the Transitway was found adequate in 1994, and the MBTA issued its Section 61 Finding in 1995. Also in 1994, FTA issued its Final Record of Decision, concluding NEPA review of the Transitway, and a Memorandum of Agreement was executed with the Massachusetts Historical Commission, containing the MBTA's commitments to mitigate impacts on historic and cultural resources.

In June 2004, the MBTA filed a Notice of Intent/Notice of Project Change for the project in which the MBTA proposed two changes over what had been previously reviewed and approved in both MEPA and NEPA. The NOI/NPC described a series of alignment alternatives each of which had in common the core

[1] In parallel to this MEPA review process, the MBTA is also filing a federal environmental review document with the Federal Transit Administration (FTA) pursuant to the requirements of the National Environmental Policy Act (NEPA). The document is a Supplemental Draft Environmental Impact Statement/Supplemental Environmental Impact Report (SDEIS/SEIR). For simplicity sake, the document is frequently referred to as the *"environmental review document."*

tunnel segment alignment from South Station to Boylston Station that follows Essex Street (rather than Avery Street, as shown in the 1994 FEIR/FEIS), modification that was developed to reduce the project's impacts on historic and archeological resources, particularly at the Boston Common. The NOI/NPC also identified a series of alignment alternatives for connecting the project to Washington Street.

After a robust public review and comment period, EOEA developed a scope for the SEIR as part of a Certificate on the NPC dated August 23, 2004. Correspondingly, the FTA concurred that the scope for the EIR could also be used as the scope in NEPA. The attached environmental document was prepared to respond to all of the issues raised in the scope and to respond to all of the comments raised during the public comment period.

The MBTA has distributed a copy of this SEIR to all agencies on the MEPA circulation list set forth under 310 CMR 11.16 as well as to those required by the FTA. In an attempt to provide the document in the most reader-friendly version, and to reduce waste, the MBTA sent a letter, with a return postcard, to each of last year's commenters providing an opportunity to receive the environmental document in the format that best served her/his needs. Each commenter was given the option of receiving either a hard copy or on CD ROM, the stand alone Executive Summary or to receive no version at all. All commenters who did not respond to the request were provided with a CD ROM version. The environmental document will also be posted on the MBTA website at www.allaboutsilverline.com on or before May 31st. Lastly, we will notify the long list of stakeholders, abutters, advocacy groups or other individuals and organizations that have an interest in this project informing them of the documents availability. This will result in a very wide notification that reaches all of the interested parties.

Additionally, the MBTA will hold a series of public hearings on the project. Two public hearings will be held at which members of the public may comment. A transcript of each hearing will be made and forwarded to both EOEA and FTA. The hearings will be held:

Wednesday June 29, 2005
The Boston Renaissance Charter School
250 Stuart Street (Park Square)
6:30 PM to 8:30 PM

Thursday, June 30, 2005
Emerson College
80 Boylston Street (The Little Building)
Emerson Conference Room – 2nd Floor
2PM to 4PM

I look forward to a rigorous and thorough public review of this document, particularly considering that the Silver Line project is such a major undertaking and has the potential to affect the community in so many different ways. By having an interactive process that solicits the public's comments and involvement, I believe that the MBTA can build community support for this important project and ultimately build a better transit line.

I look forward to working with your staff on this project. If you have any questions, do not hesitate to contact me.

Sincerely,

Michael H. Mulhern
General Manager

SILVER LINE PHASE III
SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT/SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT (SDEIS/SEIR)

ABSTRACT

The SDEIS/SEIR examines the environmental, community, operational and construction impacts of completing the Massachusetts Bay Transportation Authority's (MBTA) bus rapid transit (BRT) service, the Silver Line. Phase III of the Silver Line Project will complete this BRT system by providing the essential connection between Phase I (now in operation along Washington Street) with Phase II (now in operation along the South Boston Waterfront). Upon completion, Phase III is expected to significantly reduce existing and anticipated traffic congestion in the Phase III corridor, realize significant travel time savings, generate substantial transportation, environmental, economic development benefits locally, as well as enhance the value of existing transit investments by improving connections or providing alternatives to the Green and Orange Lines of the rapid transit system. This SDEIS/SEIR considers several alternatives including the No Build Alternative, the Baseline Alternative, as well as four Build Alternatives: Tremont Street/New England Medical Center (NEMC), Stuart Street/NEMC, Charles Street/NEMC, and Columbus Avenue. These four Build Alternatives, all of which are located in the City of Boston and are approximately one-mile long, will connect the two existing Silver Line services into a new tunnel referred to as the Core Tunnel Segment. The Core Tunnel Segment, which was analyzed in a prior environmental review process, includes new connections at the existing Boylston Street (Green Line) and Chinatown (Orange Line) Stations. This SDEIS/SEIR examines the environmental impacts of certain changes to that previously approved alignment.

The document is now available for public review and comment. Two hearings will be held at which members of the public are invited to attend and to provide comments. The hearings will be held:

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The Boston Renaissance Charter School
250 Stuart Street (Park Square)
6:30 PM to 8:30 PM

Thursday, June 30, 2005
Emerson College
80 Boylston Street (The Little Building)
Emerson Conference Room – 2nd Floor
2PM to 4PM

Comments on the document may be submitted in writing or may be made orally at the public hearings. A 60-day comment period has been established. Comments must be received no later than July 22, 2005. Written comments may be addressed to:

Andrew D. Brennan
Director of Environmental Affairs
Massachusetts Bay Transportation Authority
10 Park Plaza, Room 6720
Boston, MA 02116
silverlinecomments@mbta.com (e-mail)

Secretary Ellen Roy Herzfelder
EOEA, Attn: MEPA Office
William Gage, EOEA No. 6826/11707
100 Cambridge Street, Suite 900
Boston MA 02114

Additional information concerning the document and how to comment on it can be found at the Silver Line website at www.allaboutsilverline.com or by calling Andrew Brennan 617-222-3126.

Approvals:

Mary Beth Mello
Mary Beth Mello
Acting Regional Administrator, Region 1
Federal Transit Administration

5/12/05
Date of Approval for Circulation

Michael H. Mulhern
Michael H. Mulhern
General Manager
Massachusetts Bay Transportation Authority

5/12/05
Date of Approval for Circulation

Volume I – Supplemental Draft Environmental Impact Statement/Environmental Impact Report

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Attachments

A MEPA Certificate and Response to Scope Comments
B Draft Section 61 Findings
C Agency Correspondence
D List of Preparers
E List of Reviewers
F References
G Acronyms and Glossary of Terms

Volume II – Response to Comments on Notice of Project Change

Volume III – Technical Appendices

A. Design & Operation
B. CTPS Memorandum
C. Noise & Vibration
D. Traffic
E. Hazardous Material
F. Cultural Resources
G. Construction

Executive Summary

1.0 Introduction

This Executive Summary provides a summary discussion of the alternative tunnel alignments and portal locations for Phase III of the Massachusetts Bay Transportation Authority's (MBTA) Silver Line Bus Rapid Transit (BRT) project as presented in the complete Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR) document. The Silver Line combines the services provided by the MBTA's South Boston Piers Transitway (EOEA No. 6826), now Silver Line Phase II, and the Washington Street Replacement Transit Service (EOEA No. 11707), now Silver Line Phase I, as well as the Massachusetts Port Authority's (Massport) Airport Intermodal Transit Connector (AITC). Phase III of the project will connect Phase I, in operation along Washington Street between Dudley Square and downtown, and Phase II, extending from South Station to the South Boston Waterfront and Logan Airport. The full project is shown in Figure ES-1.

This SDEIS/EIR has been prepared and circulated as a combined federal and state document to satisfy the requirements under the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) for consideration of the environmental impacts of the Phase III project. The SDEIS/EIR is also intended to satisfy federal and state environmental justice requirements, as well as the requirements of Section 4(f) of the Department of Transportation Act of 1966 relating to the use of parklands for transportation projects and Section 106 of the National Historic Preservation Act of 1966 relating to preservation of historic resources. In accordance with these requirements, this document describes alternatives to the proposed action, as well as the probable adverse effects to the human and natural environments as a result of construction and operation of the Phase III project, and measures incorporated to reduce and mitigate environmental harm and adverse impacts on the surrounding community. This document has been prepared in accordance with the Massachusetts Executive Office of Environmental Affairs' (EOEA) August 23, 2004 Certificate, which identifies the range of alternatives considered for Phase III of the Silver Line, and the scope of potential impacts to the human and natural environments to be analyzed. The Federal Transit Administration (FTA) concurred with the scope detailed in the EOEA Certificate in a letter dated December 8, 2004.

Through this SDEIS/EIR, the MBTA is seeking public input on the Phase III alternatives considered. That input will be used to support selection by the MBTA of the preferred alternative for implementation. Final environmental documentation will identify the preferred alternative and respond to substantive comments received on this draft document.

2.0 Purpose and Need Summary

The purpose of the Phase III project is to physically integrate Silver Line Phases I and II, and provide direct connections to existing MBTA transit services. By integrating previously separate projects into the Silver Line, the MBTA is improving the service it will provide and is creating substantial new opportunities for people living in Boston's residential neighborhoods, including Roxbury, Chinatown, Midtown, the South End, Back Bay and South Boston, to access the downtown financial district, new development in the South Boston Waterfront area, and Logan International Airport. The project will provide direct and efficient connections to other major elements of the regional rapid transit system (the Red, Orange, and Green Lines), thereby improving service and relieving demands on existing transit system capacity in the Boston core.

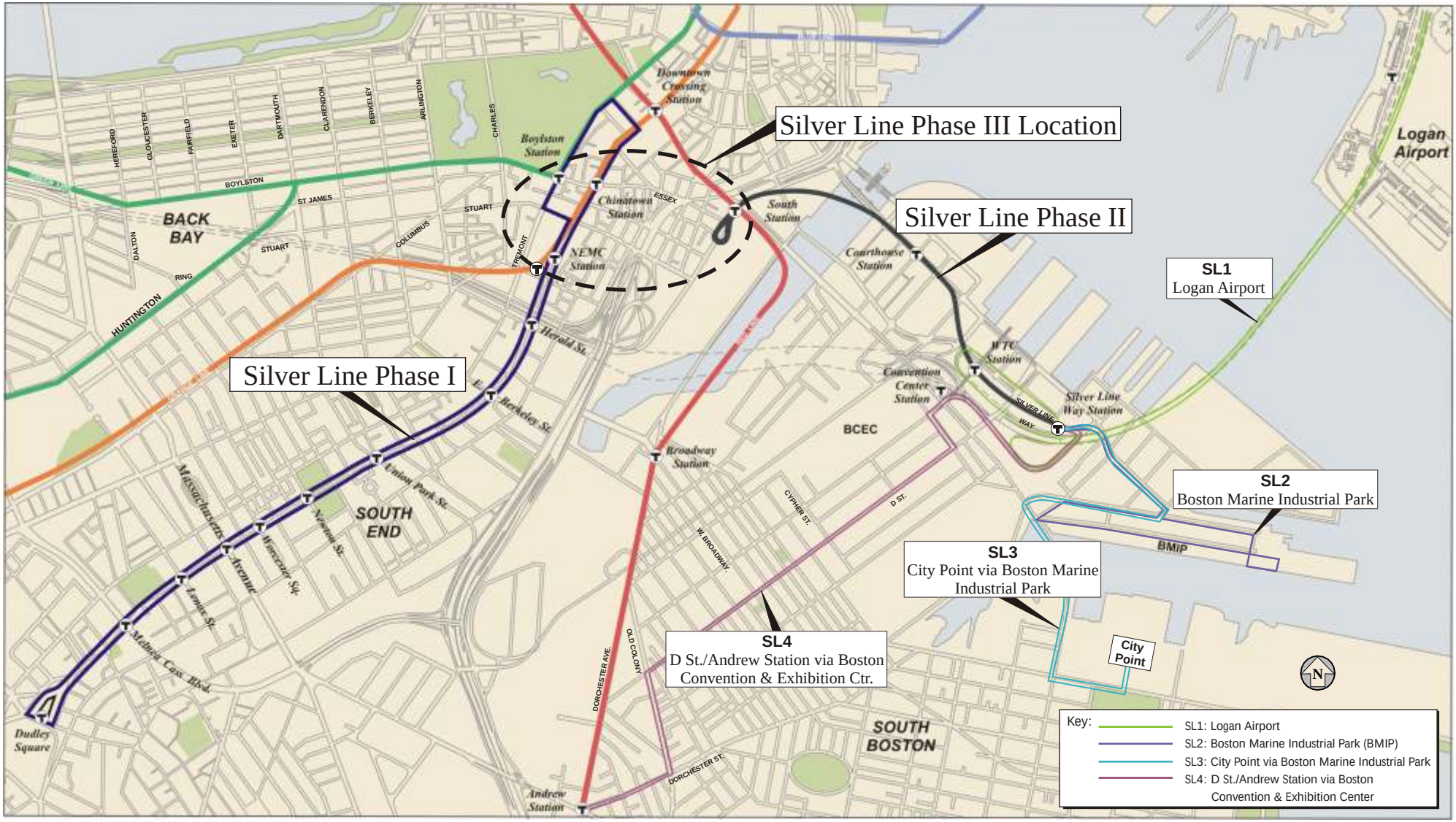

Figure ES-1
Silver Line Full Build

The project will serve to reduce transfers and overall travel time for Boston residents located in existing urban neighborhoods in Roxbury, Chinatown, Midtown, the Back Bay, and the South End, providing them with improved rapid transit service to downtown Boston, the Waterfront area, and the Airport.

The Phase III tunnel section represents the "missing link" between Phase I, now in operation between Dudley Square and downtown Boston, and Phase II, providing service between downtown Boston and the South Boston Waterfront and Logan Airport. The link that will be provided by Phase III will mean that other links can be made: links between communities, between people and jobs, between opportunities for growth. In addition, investment in transit in Boston's urban core helps further anchor the city as the economic engine of the region, while providing transportation and environmental benefits by reducing regional automobile travel and the attendant congestion and air pollution. By completing the entirety of the Silver Line system, Phase III will help reap substantial transportation, environmental, and economic benefits.

Without the Phase III tunnel, air quality commitments in the State Implementation Plan as well as commitments in the Administrative Consent Order for the Central/Artery Project which specifies implementation of the full Silver Line project would not be met. Finally, Phase III of the Silver Line meets key sustainable development principles identified by the Massachusetts Office for Commonwealth Development, including increasing access to transportation options and investing in transportation infrastructure that encourages smart growth.

Completion of the Silver Line is needed to serve existing and projected development throughout the corridor, improve mobility options for Boston's residential neighborhoods by improving travel times, reducing transfers, and connecting to existing transit lines, relieve capacity constraints on existing MBTA transit lines and at heavily utilized stations such as Park Street, Downtown Crossing, and South Station, and support the continued vitality of Boston's urban core by reducing congestion and enhancing the human and natural environments.

3.0 Description of Proposed Action

The Phase III tunnel section provides an operational link between Phase I and Phase II of the Silver Line. The MBTA has identified a core tunnel segment ("Core Tunnel Segment") for Silver Line Phase III. This Core Tunnel Segment is common to all of the portal alignment alternatives considered in this SDEIS/EIR; its completion represents the full build-out of the previously reviewed and approved Transitway project. It follows an alignment from South Station (where it connects to Phase II) along Essex and Boylston Streets, to a turnaround loop at the intersection of Charles and Boylston Streets, which will allow needed operational flexibility for the Silver Line system. The Core Tunnel Segment includes two new Silver Line stations at Boylston Street (connecting to the Green Line) and at Chinatown (connecting to the Orange Line).

The following four alternative portal alignments that could complete the connection to Phase I service on Washington Street are evaluated in this SDEIS/EIR:

- Tremont Street/New England Medical Center (NEMC) Portal
- Charles Street/ NEMC Portal
- Stuart Street/NEMC Portal
- Columbus Avenue/Columbus Avenue Portal

4.0 Alternatives Considered

In compliance with FTA guidelines, the specific alternatives evaluated include a No-Build Alternative, a Baseline Alternative, and the Build Alternatives.

The MBTA has evaluated a number of alignment alternatives to avoid or minimize permanent impacts to important cultural and community resources (such as the Boston Common and the Chinatown YMCA), as well as to reduce the overall cost of the project so as to make it more competitive for Federal funding. The Build Alternatives evaluated in this SDEIS/EIR represent feasible alternatives developed through that preliminary screening and evaluation process. The Notice of Project Change (NPC) and Notice of Intent (NOI) that initiated the scoping process for this SDEIS/EIR presented the following three Build Alternatives, each of which had a Core Tunnel Segment and turnaround loop in common, but differed in the balance of the tunnel alignment to a portal and ramp to grade: 1) Tremont Street Alignment with a portal at the NEMC; 2) Charles Street Alignment with a portal at NEMC; and 3) Charles Street Alignment with a portal at Elliot Norton Park. In addition, the MBTA requested public comment as to whether a Columbus Avenue Alignment Alternative should be considered. As a result of the public scoping process, the Charles Street Alignment with a portal at Elliot Norton Park was eliminated from consideration due to its potential for permanent adverse impacts to parkland, and the Columbus Avenue Alignment was added as one of the Build Alternatives to be considered. Following the scoping process, the FTA requested that an alignment that followed Charles Street, Stuart Street and Tremont Street (the Stuart Street alignment) to a portal at NEMC also be considered as a Build Alternative. Table ES-1 presents a comparative summary of the alignment alternatives considered leading to the four Build Alternatives evaluated in this SDEIS/EIR.

4.1 No-Build Alternative

The No-Build Alternative includes future conditions that would exist if no transportation improvements associated with Silver Line Phase III were implemented. It provides the basis against which the environmental impacts of the other alternatives are evaluated. This alternative consists of Silver Line Phase I (currently in operation along Washington Street between Dudley Station and Downtown Crossing/Temple Place), and Silver Line Phase II (providing service from South Station to the South Boston waterfront and residential areas and to Logan Airport).[1] It assumes that Silver Line Phases I and II would not be connected, and that they would continue to operate as separate services. The No-Build Alternative further consists of the transportation network contained in the Regional Transportation Plan for the year 2025, consistent with FTA planning policy and guidelines.

[1] Silver Line Phase II service to the Boston Marine Industrial Park (BMIP) and City Point in South Boston as well as Sunday service to Logan Airport opened in December 2004. Service to Andrew Station via D Street and expanded Logan service will begin later in 2005.

Table ES-1 — Comparative Summary of Alternatives Considered

Alternative	South Station to Boylston Station* alignment	Chinatown Station	Boylston Station	Mid-Block Station	Turn around Loop	Boylston Station* to Portal Alignment	Portal Location	Comments/ Reasons For Elimination
1993								
1993 ROD Alignment	Essex Street, Ave de Lafayette, Hayward Pl, Avery St	Under Avery Street	Under Boston Common	N/A	Under the Central Burying Ground, Boston Common	None	None	New development within ROW interferes with original alignment. Boston Common impacts.
2002								
2002 Preliminary Engineering Request Alignment	Essex Street, Boylston Street	Under Essex/ Boylston Streets	Under Boston Common	N/A	Under Boston Common	Tremont Street	Chinatown YMCA	Community impacts from taking YMCA. Boston Common impacts. High cost with an underground NEMC station.
2003 3rd Annual Update								
Group 1								
2003 New Starts	Essex Street, Boylston Street	Under Essex/ Boylston Streets	Under Boston Common, one platform	N/A	Under Boston Common	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	One platform at Boylston Station inadequate for ridership demand. Boston Common impacts.
Mid-Block/No Loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange Line	None	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand. No-Loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.
Mid-Block/ Bidirectional South Station loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange	South Station	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand. South Station bidirectional loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.
Mid–Block/Non-Revenue loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange	Under Boston Common	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand.
Group 2								
Revised 2003 New Starts	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boston Common, two platforms	N/A	Under Boston Common	Tremont Street	Between NEMC garage and the Doubletree Hotel	Boston Common impacts.
Tremont Street w/Stuart Street loop	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Tremont Street	N/A	Stuart Street	Tremont Street	Between NEMC garage and the Doubletree Hotel	Failure to meet grade/operational criteria due to location of Boylston Station and Stuart St. loop. High cost of impacts to Loews Hotel site.
Charles St/ Elliot Norton Park portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles Street	Elliot Norton Park	Permanent, adverse impacts to Elliot Norton Park.
SDEIS/EIR Alternatives								
	Core Tunnel Segment					**Portal Alignments**		
Charles St/NEMC portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles Street	Between NEMC garage and the Doubletree Hotel	SDEIS/EIR alternative
Tremont St/NEMC Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Tremont Street	Between NEMC garage and the Doubletree Hotel	2004 New Starts alternative, SDEIS/EIR alternative
Stuart St./NEMC Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles, Stuart, and Tremont Streets	Between NEMC garage and the Doubletree Hotel	SDEIS/EIR alternative
Columbus Ave /Columbus Ave. Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Columbus Avenue	Columbus Avenue between Arlington and Berkeley Streets	SDEIS/EIR alternative

* Refers to Mid-Block station for those alternatives which propose a single mid-block station, since a separate Boylston Station would not be constructed.

4.2 Baseline Alternative

This alternative serves as the FTA-approved baseline for quantifying the transportation and cost effectiveness of the Build Alternatives under the FTA New Starts process.[2] It represents a lower cost option as compared to the Build Alternatives that maximizes the use of existing transportation infrastructure. Under the Baseline Alternative, Phases I and II would remain as separate services, but revenue service on each would be increased to a level consistent with that proposed for Phase III operation. Peak headways for Phase I would be decreased from 4.0 minutes to 3.3 minutes. Phase II peak headways would decrease from 1.3 minutes to 0.8 minutes in the tunnel between South Station and the World Trade Center. Connections between Phases I and II would be made via transfer to and from the Red Line at Downtown Crossing Station (to access destinations along Washington Street) and at South Station (to access the South Boston Waterfront and Logan Airport).

4.3 Build Alternatives

Each of the Build Alternatives has in common the Core Tunnel Segment, as described below. This Core Tunnel Segment configuration provides the option of connecting to any of the following alignments, with a portal either at the NEMC or on Columbus Avenue:

- Tremont Street Alignment/NEMC Portal
- Charles Street Alignment/NEMC Portal
- Stuart Street Alignment/NEMC Portal
- Columbus Avenue Alignment/Columbus Avenue Portal

See Figure ES-2 for the Build Alternative alignments.

4.3.1 Core Tunnel Segment

The Core Tunnel Segment is substantially similar to the alignment studied in the 1993 *South Boston Piers/Fort Point Channel Transit Project Final Environmental Impact Statement/Final Environmental Impact Report* (FEIS/FEIR), for which the FTA issued a Record of Decision and the Massachusetts Executive Office of Environmental Affairs issued a Certificate of Adequacy. The Core Tunnel Segment for Phase III of the Silver Line described in this SDEIS/EIR relocates the originally proposed tunnel alignment to avoid interference with the Millennium Place development which occupies an area within the original alignment and to minimize disruption to the Boston Common. It consists of approximately 3,000 feet of tunnel, extending along an Essex Street and Boylston Street alignment from the existing Silver Line Phase II tunnel in Atlantic Avenue near South Station to a turnaround loop under the intersection of Charles and Boylston Streets, west of the Boylston Silver Line Station. The Core Tunnel Segment will result in impacts to the Boston Common. The impacts will include parklands, archaeological resources and historical resources. Since these impacts are associated with the Core Tunnel, they will also impact any of the alignments under consideration.

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2 FTA's New Starts process involves the evaluation and rating by FTA of projects seeking discretionary Section 5309 New Starts funding. This evaluation is conducted according to several key criteria related to a project's justification and financial feasibility. Chief among these criteria is cost effectiveness, which measures the annualized capital and operating cost of each build alternative divided by transportation system user benefits as compared to an FTA-approved Baseline Alternative. FTA defines transportation system user benefit as all annual travel-related benefits in terms of hours saved by all users of the transit system, including both existing riders and new riders. Cost effectiveness is a key measure used by the FTA in the New Starts rating process – it accounts for half of the project justification rating assigned by FTA – and for this reason is a critical evaluation criterion for the Silver Line Phase III alternatives analysis.

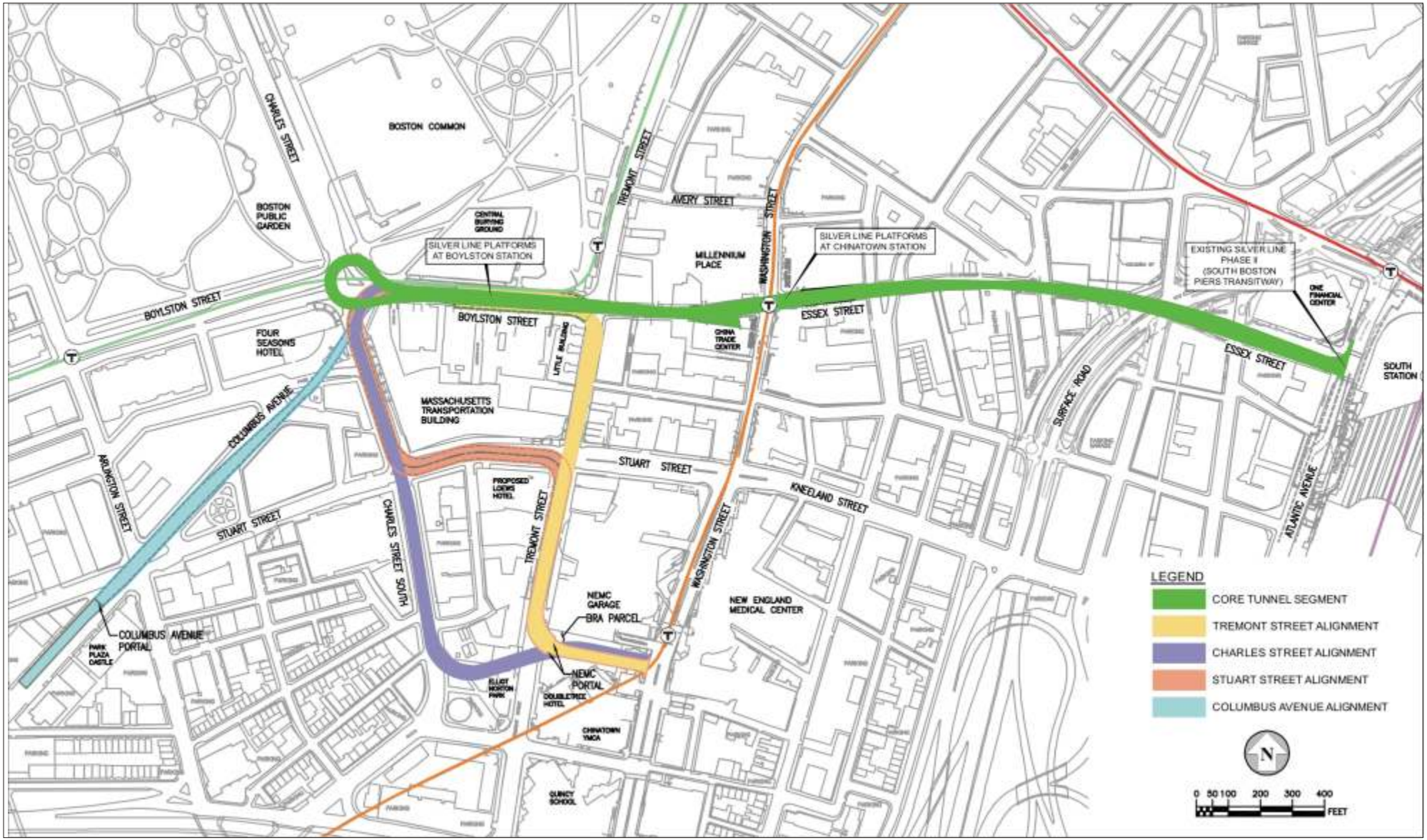

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Figure ES-2
SDEIS/EIR Phase III Alternatives

Operationally, this loop allows for the turnaround of outbound buses, as needed, to meet peak ridership demands to and from the South Boston Waterfront area. The loop will direct buses from the upper outbound tunnel to the lower inbound tunnel for their return to the Boylston Silver Line Station.

This Core Tunnel Segment connects to the existing Phase II tunnel in Atlantic Avenue near South Station with two tunnels in a side-by-side configuration. The inbound and outbound tunnels descend to pass under the New East Side Interceptor (NESI) sewer and the Dewey Square Tunnel, now reconfigured as the Central Artery southbound tunnel (CASB). Once west of the CASB, the individual single-lane inbound and outbound Phase III Silver Line tunnels in Essex Street transition to a stacked alignment, providing for a reduced construction influence zone. The alignment continues westerly within the Essex Street right-of-way, passing under the Chinatown Orange Line Station and Washington Street. A Chinatown Silver Line Station is proposed at this location with direct pedestrian connections to the Orange Line (see *Chinatown Station* below for description). From there the tunnels cross under Tremont Street, still in a stacked configuration within the Boylston Street right-of-way (ROW), passing adjacent to, but at a lower elevation than the existing Green Line tunnels and the Boylston Green Line Station. A Boylston Silver Line Station is proposed along Boylston Street west of Tremont Street with direct pedestrian connections to the Boylston Green Line Station (see *Boylston Station* below for description). After the Boylston Station, the Core Tunnel Segment of the Silver Line Phase III terminates at a turnaround loop to be located within the right-of-way of the intersection of Charles and Boylston Streets.

4.3.1.1 Chinatown Station

The new Chinatown Silver Line Station will provide two platforms, each 220 feet in length and located along the Essex Street ROW below the existing Chinatown Station, which offer a free transfer connection to the Orange Line (see Figures ES-3 and ES-4). The Silver Line tunnel alignment is stacked at this location due to ROW restrictions, resulting in two new underground levels at approximately 57 and 83 feet below the surface. The physical layout of the proposed station consists of two mined Silver Line tunnels, containing platforms, to pass below and perpendicular to the existing Orange Line station. Vertical circulation and ancillary spaces will be located at either end of the platform tunnels (and on either side of the Orange Line station) to provide all necessary connections between the Orange and Silver Lines. Silver Line passenger circulation will tie directly into that of the existing Orange Line, and Silver Line passengers will use the pre-existing Chinatown Station entry points. Modifications to the existing station will be necessary to provide enhanced egress requirements for station occupancy loads, as well as to provide optimal common entry to the station and connections between the Orange and Silver Lines.

Passenger circulation within the combined Orange Line/Silver Line station will consist of unobstructed, ADA (Americans with Disabilities Act) compliant pathways interconnecting all lobbies, platforms, and street entrances. Currently, the existing Orange Line lobbies are not connected to each other, and a patron wishing to reverse directions on the system must exit the station at the surface, cross Washington Street, and re-enter (and re-pay) to access the opposing platform. Under the proposed station layout, these existing lobbies will be connected by both the outbound and inbound Silver Line levels which pass beneath and perpendicular to the Orange Line platforms. The vertical circulation nodes, which “book-end” the Silver Line platforms, are located at either side of the existing Orange Line station and will collect all passengers and convey them to either the northbound or southbound Orange Line lobbies. Each node will contain stairs, elevators, and escalators providing ADA compliant connections. Signage will be a critical aspect to an efficient circulation scheme, and accessibility requirements will be met along all paths. Access from the street, both standard and ADA will remain as they exist today, with stairs and elevators leading directly to unpaid lobbies. Passengers, after paying fares, will be able to connect at the same level to the Orange Line platform, or to descend via the previously mentioned vertical circulation node to connect with the Silver Line platforms below.

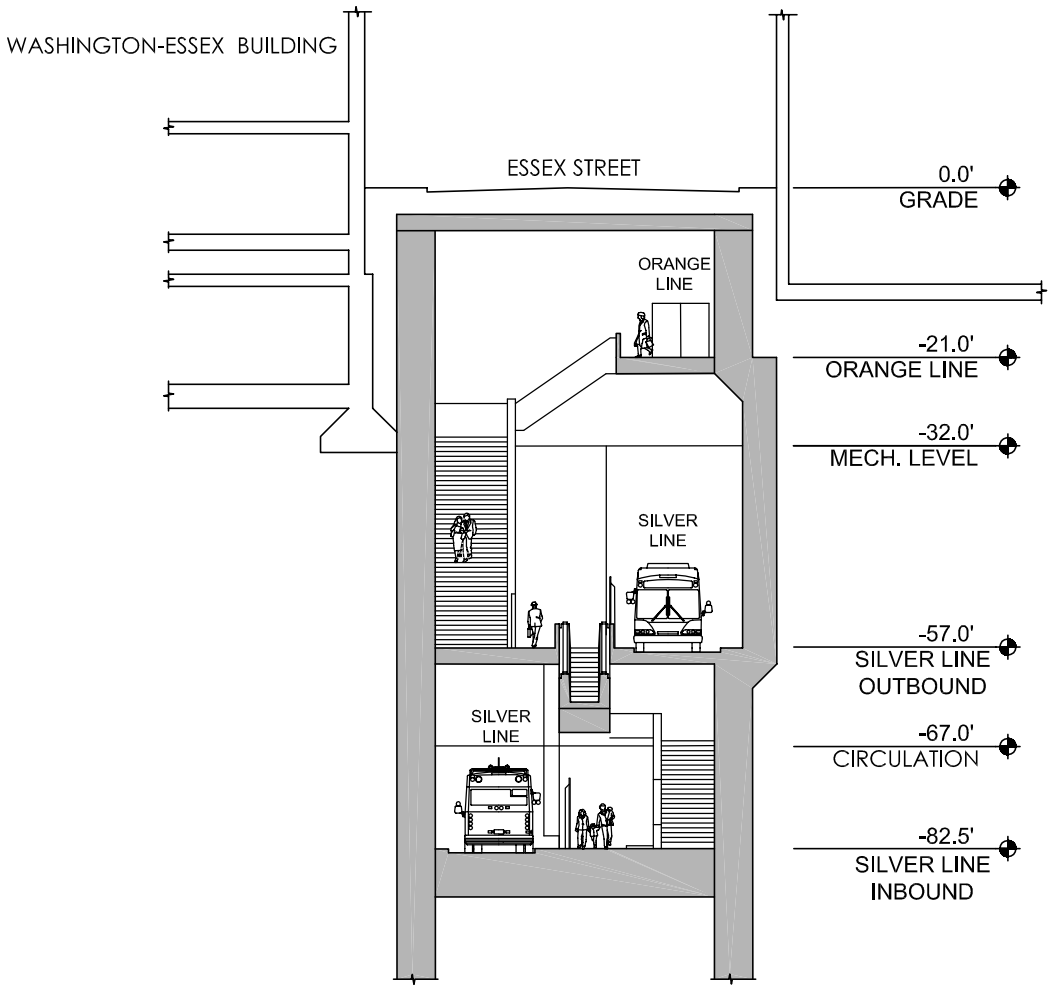

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Figure ES-3
Cross-Section of Chinatown Station

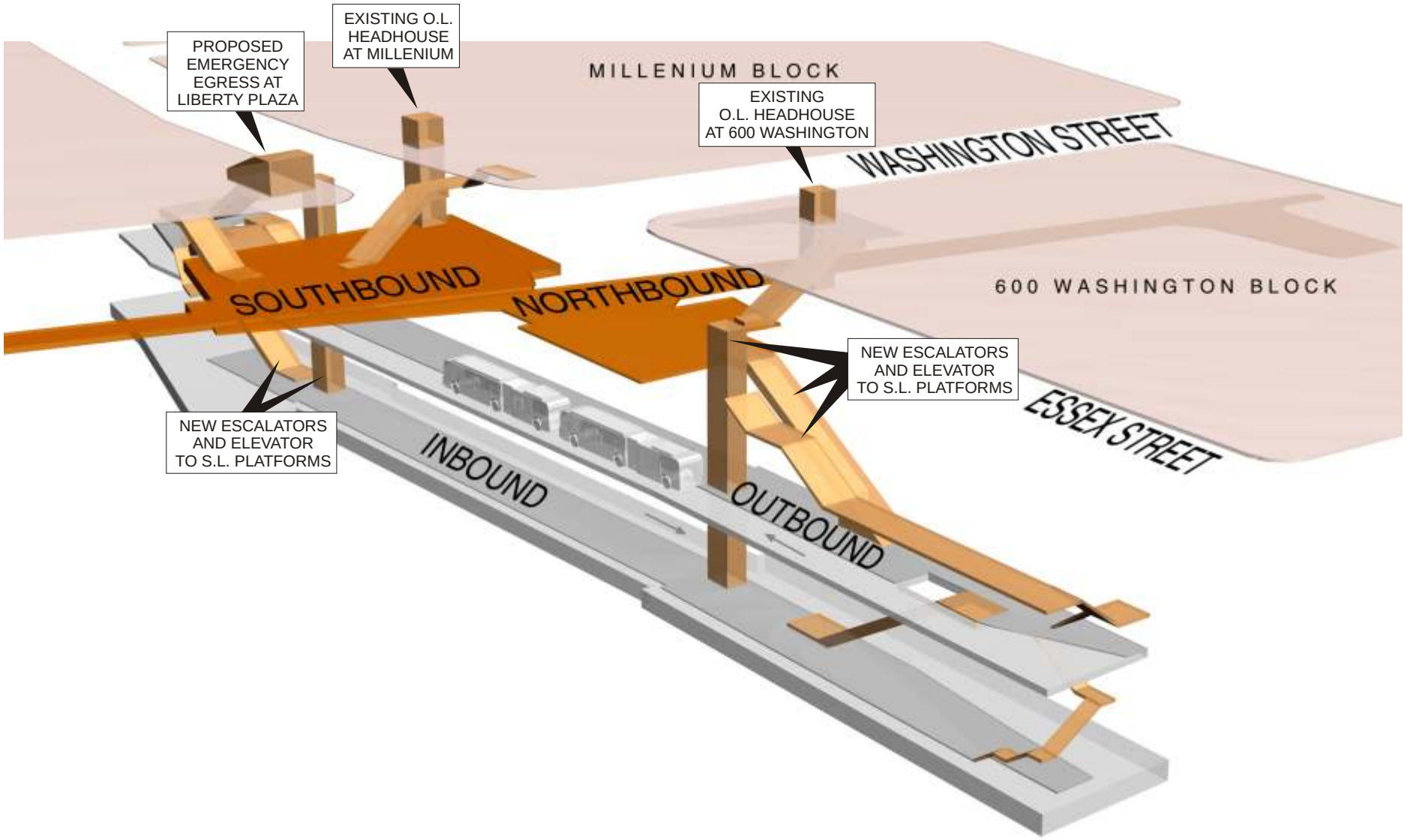

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Figure ES-4
Chinatown Station
Orange Line/Silver Line Connections

An additional egress point is proposed to accommodate increased passenger volume as a result of the addition of Silver Line ridership. This egress only structure, which would connect directly to the existing Orange Line southbound lobby, would be located either on the plaza in front of the China Trade Building or at the basement within the China Trade Building itself. The Orange Line northbound currently contains adequate egress and will not require additional points of egress.

Several surface penetrations will be required for station and tunnel ventilation. Two emergency tunnel ventilation shafts are required, one at each end of the station. The easterly ventilation shaft would be located on the traffic island at the intersection of Harrison Avenue and Essex Street. The westerly ventilation shaft would be located on the plaza in front of the China Trade Building. Other station ventilation shafts are planned as surface grates within the sidewalk along Boylston and Essex Streets. These structures will be designed and placed with sensitivity to their urban surroundings and the flow of vehicular and pedestrian traffic (see Figure ES-5 for Chinatown Station surface elements).

4.3.1.2 Boylston Station

The new Boylston Silver Line Station will be located directly below and aligned with Boylston Street, and adjacent to the existing Green Line tunnel between Tremont Street and 134 Boylston Street. As a result of the narrow ROW, the Silver Line platforms will be stacked at this station. The main lobby, at 22 feet below grade, will be located at the east end of the station. Each platform will be 220 feet long, with the outbound platform at approximately 50 feet below grade and the inbound platform at approximately 76 feet below grade (see Figures ES-6 and ES-7). A mezzanine level will provide access to both the Silver and Green Line platforms. Existing unused subway tunnels would be utilized to provide a convenient and direct connection from the mezzanine to the Green Line platforms at the existing Boylston Station. Modifications of the existing Green Line station will be required to provide this direct connection.

Passenger circulation within the combined Green Line/Silver Line station will consist of unobstructed, ADA compliant pathways interconnecting all lobbies, platforms, and street entrances. As is also the case at Chinatown Station, the existing Green Line lobbies are not connected; therefore efforts will be made to provide the most efficient connections possible. Under the proposed station layout, this connection would be provided by a common paid zone lobby located within or near the existing abandoned tunnels below the intersection of Tremont and Boylston Streets. From this central location at the adjoining ends of the proposed and existing stations, passengers can access all platforms within the station complex without incurring additional fares. Escalators and an elevator will serve the connection to both Silver Line levels below, and a separate elevator and escalator bank will provide a connection to the inbound Green Line platform. A pedestrian ramp (with ADA compliant slope and landings) will connect the lobby with the outbound Green Line platform through an existing maintenance vehicle storage tunnel. The existing tunnel will be upgraded to address passenger safety and security issues. All of these connections will occur within the paid zone and will be ADA compliant. The proposed main access from street level to this common lobby will contain an unpaid-zone elevator for ADA compliance and will be located in the immediate area of the Boylston/Tremont intersection. The common lobby will also be accessible from the existing Green Line entry kiosks.

Passenger access to the Boylston Silver Line Station would utilize the area at the corner of the Little Building at 80 Boylston Street. General circulation will consist of escalators, stairs, and an ADA-compliant elevator at the east end of the station. Egress for emergency use only will be provided towards the west end of the station. The path of travel will be through a tunnel crossing under the existing Green Line alignment to a stair that will exit adjacent to the Deer Park maintenance area on the Boston Common; another egress location is proposed within the building at 120-124 Boylston Street, on the south side of the street. Proposed access improvements to the existing Green Line station include an elevator for the outbound platform, to be housed in a free-standing structure to the north of the existing Green Line outbound headhouse. (Elevator access to the inbound Green Line platform would be provided through the shared Silver Line/Green Line access in the corner of the Little Building.)

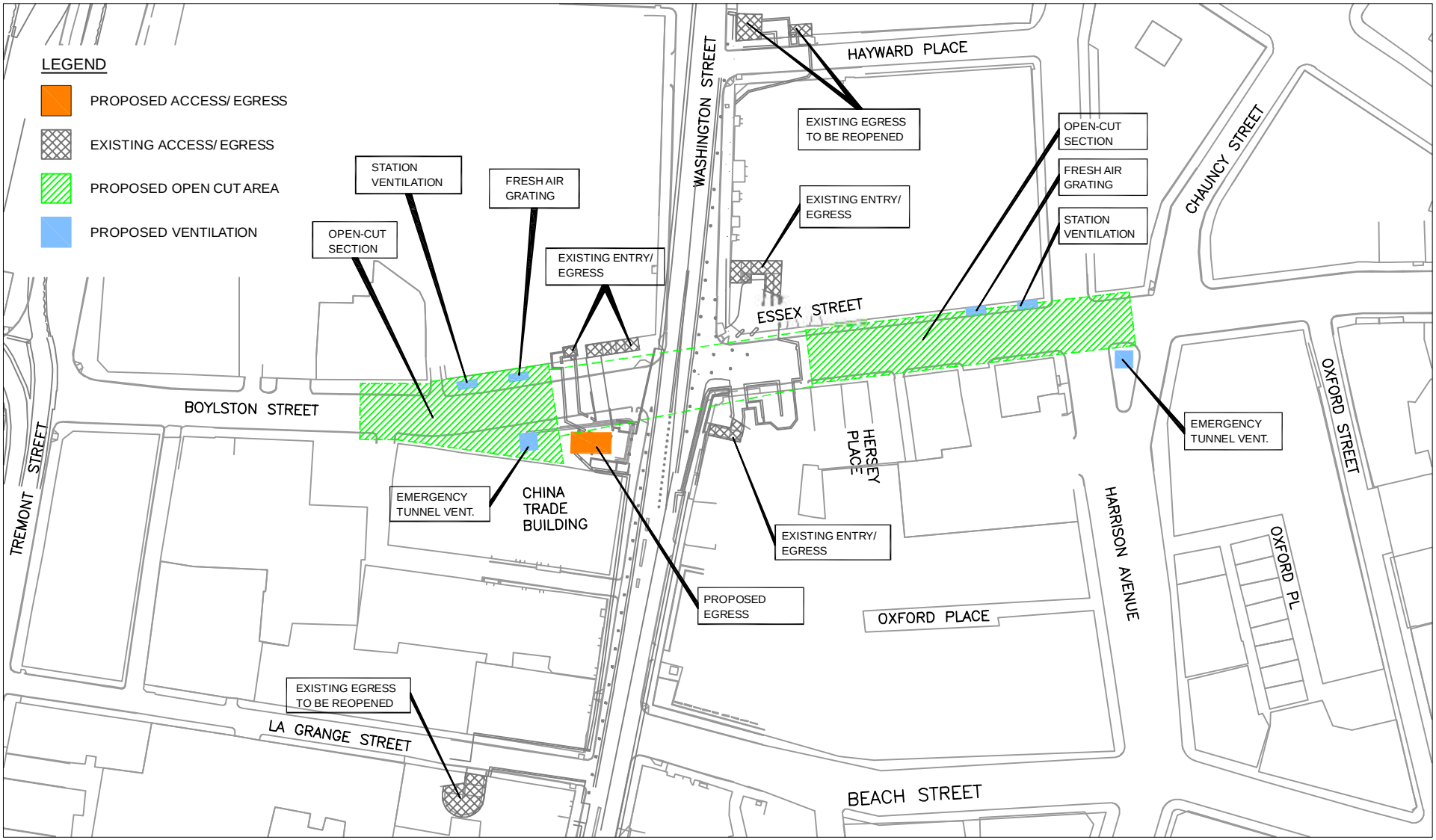

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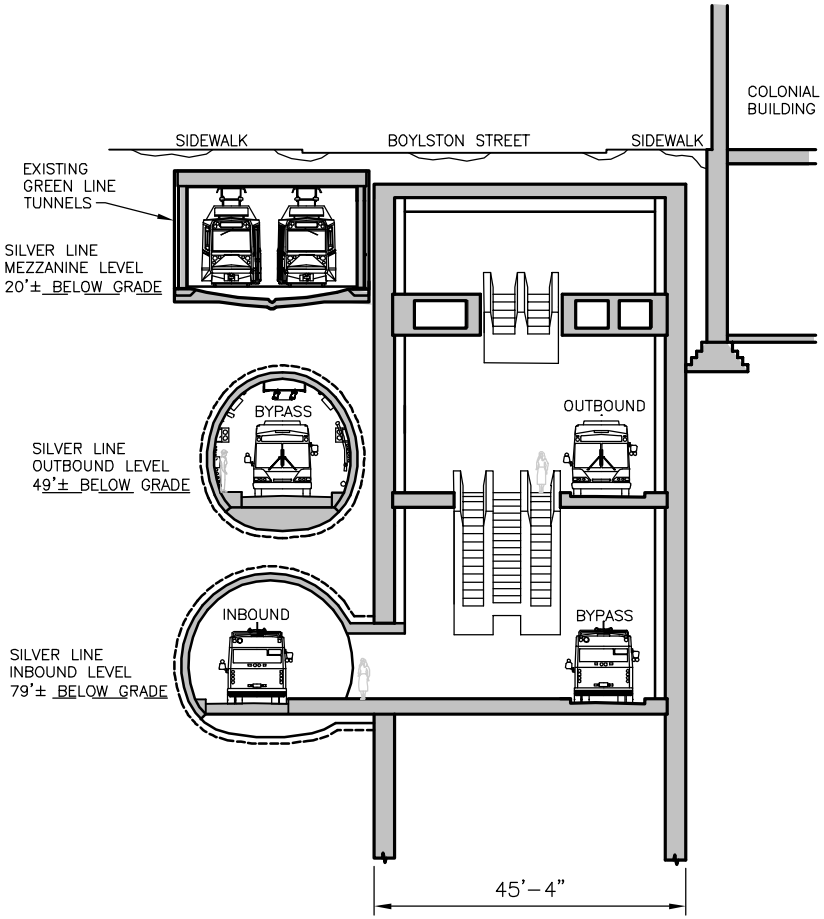
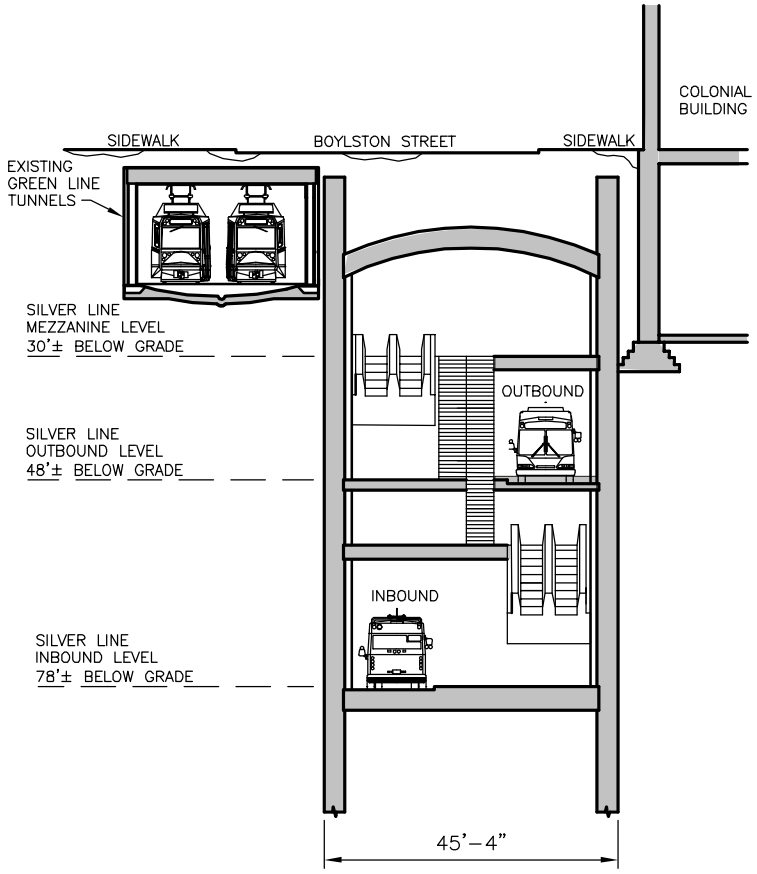
Figure ES-5
Chinatown Station Surface Elements



SILVER LINE – BOYLSTON STATION
(LOOKING EAST)
FOR TREMONT STREET ALIGNMENT



SILVER LINE – BOYLSTON STATION
(LOOKING EAST)
FOR CHARLES STREET SOUTH, STUART STREET,
AND COLUMBUS AVENUE ALIGNMENTS

Figure ES-6
Cross-Section of Boylston Station

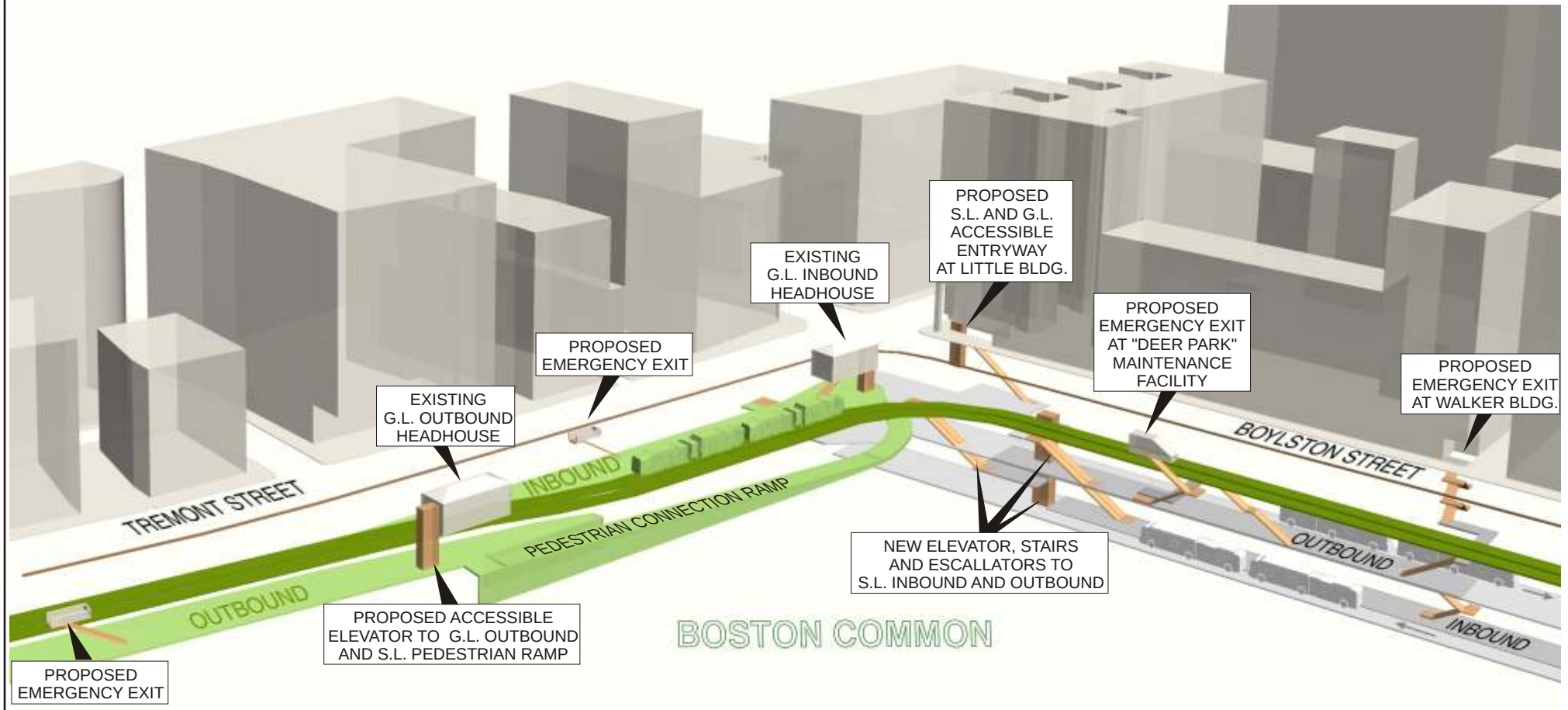


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Figure ES-7
Boylston Station
Green Line/Silver Line Connections

In addition, two emergency egress stairs will be provided, utilizing a portion of the footprint of two former Green Line headhouses that were demolished circa 1960.[3] (See Figure ES-8 for the location of surface elements associated with Boylston Station.)

As part of the Tremont Street alignment, a pair of by-pass lanes would need to be incorporated into the station, providing through-service to the turn-around loop below the intersection of Charles and Boylston Streets for revenue operations. These by-pass lanes would expand the width of the station envelope to the north, below and parallel to the existing Green Line tunnel along Boylston Street. These by-pass lanes would not be required for the remaining Build Alternatives – Charles Street, Stuart Street, Columbus Avenue. In the latter alternatives, the turn-around loop would only be used for non-revenue service.

In addition to access and egress requirements, the Silver Line Boylston Station will require ventilation shafts. The emergency ventilation shaft at the easterly end of the station will tie into the existing Green Line ventilation shaft located at the southeast corner of the Deer Park maintenance facility yard. An additional ventilation structure would be provided at the southeast corner of the Charles Street and Boylston Street intersection. Fresh air ventilation for the station would be provided through at-grade vent structures on the south side of Boylston Street in the sidewalk adjacent to the State Transportation Building. These structures will be designed and placed with sensitivity to their urban surroundings and the flow of vehicular and pedestrian traffic.

As part of the Tremont Street alignment, a pair of bypass lanes would need to be incorporated into the station, providing through-service to the turnaround loop below the intersection of Charles and Boylston Streets for revenue operations. These bypass lanes would expand the width of the station envelope to the north, below and parallel to the existing Green Line tunnel along Boylston Street. The bypass lanes would not be required for any of the other Build Alternatives – Charles Street, Stuart Street or Columbus Avenue. In these other Build Alternatives, the turnaround loop would only be used for non-revenue service[4].

In addition to access and egress requirements, the Silver Line Boylston Station will require ventilation shafts. The emergency ventilation shaft at the easterly end of the station will tie into the existing Green Line ventilation shaft located at the southeast corner of the Deer Park maintenance facility yard. An additional ventilation structure would be provided at the southeast corner of the Charles Street and Boylston Street intersection. Fresh air ventilation for the station would be provided through at-grade vent structures in the sidewalk on the south side of Boylston Street.

4.3.2 Tremont Street Alignment/NEMC Portal Alternative

The Tremont Street Alignment/NEMC Portal Build Alternative connects to the Core Tunnel Segment at the intersection of Boylston and Tremont Streets, and it extends south within the Tremont Street ROW to a portal and ramp to grade located between the NEMC garage and the Doubletree Hotel (the NEMC portal). (See Figure ES-9.) A surface stop would be provided just west of Washington Street within the Silver Line ROW.

[3] The graphic identifies locations of emergency egress-only stairs on the Boston Common. These stairs as proposed would be exposed to the weather, with only a knee-wall around the perimeter. However, the MBTA, in conjunction with the Boston Landmarks Commission, will seek approval from the Massachusetts Department of Public Safety (DPS) to allow the use of a pop-up hatch instead of the open stairwell to reduce visual impacts to Boston Common. This is a covered opening flush with the ground, with a hatch that would be opened from within in case of emergency. On other Green Line accessibility projects in significant historic resource areas (most notably Copley Station outside the Boston Public Library), the MBTA received approval to use pop-up hatches. For the purpose of this environmental review, the MBTA is showing the stairways with knee walls, in the event that DPS does not approve the pop-up system on Boston Common for emergency egress for Boylston Station, as it represents a worst case with regard to visual impacts on Boston Common.

[4] Revenue operations refer to the bus operating with passengers on-board, while non-revenue service refers to the bus using the turnaround loop without passengers on board.

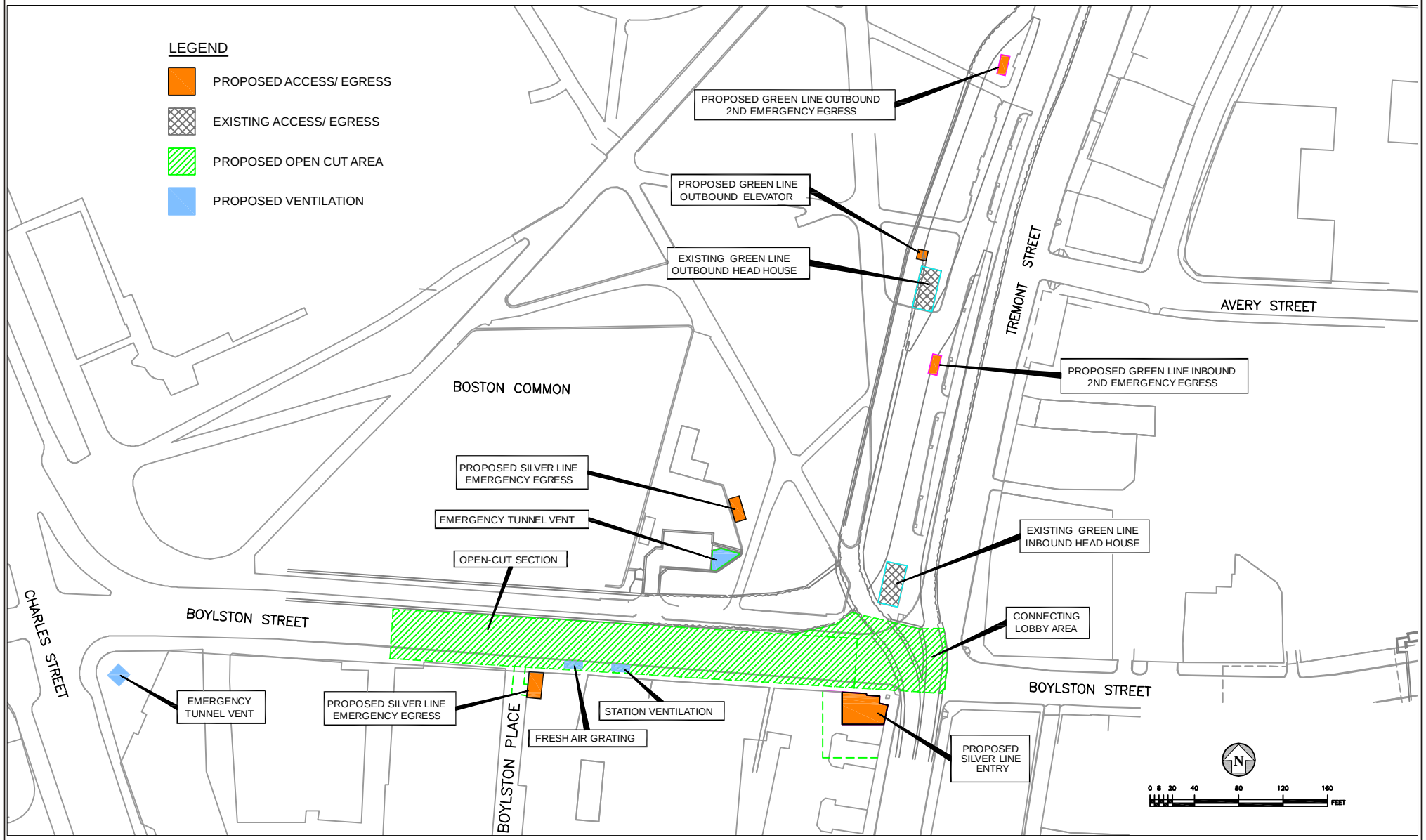

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Figure ES-8
Boylston Station Surface Elements

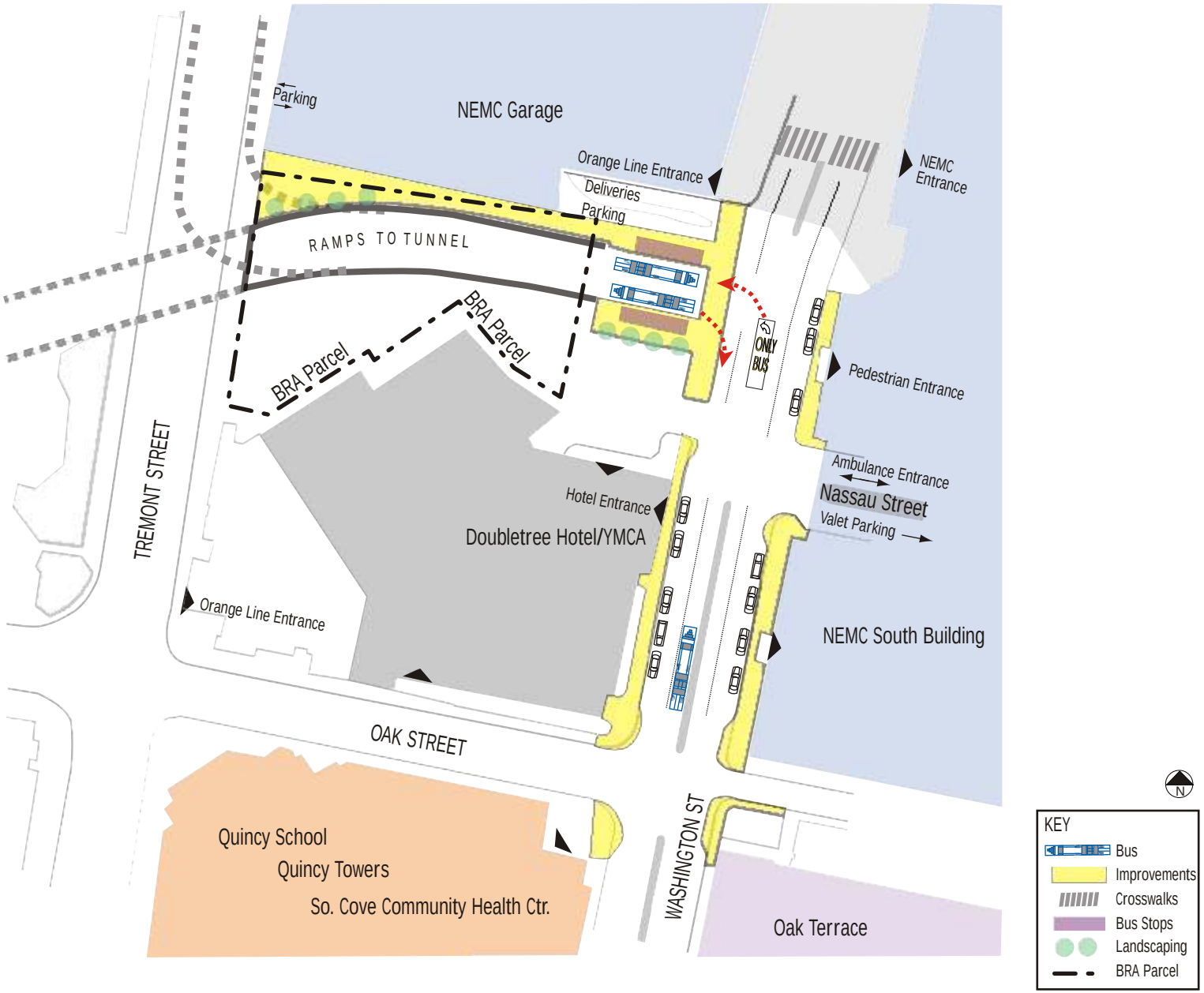

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Figure ES-9
New England Medical Center (NEMC) Portal

At the northern end of the alignment near Boylston Station, inbound and outbound tunnels are located within the Tremont Street ROW in a stacked arrangement. The tunnels transition to a side-by-side configuration at approximately LaGrange Street. The tunnels continue in a side-by-side configuration in Tremont Street to a point adjacent to the NEMC parking garage. The alignment then turns to the east as it ramps up at a grade of 5.6 percent, to a tunnel portal located east of the Tremont Street right-of-way line. The alignment continues to the east in a boat section, passing though Boston Redevelopment Authority (BRA) and Doubletree Hotel properties (currently used for parking), ending at Washington Street between the Doubletree Hotel and south of the NEMC Garage. Off-street surface bus stops would be provided at NEMC in the portal boat section within the Silver Line right-of-way. The overhead catenary wire providing power to the vehicles in the tunnel would end at the NEMC stop, where the vehicle would change from electric to diesel-powered GenSet mode. The vehicle would operate in diesel mode on Washington Street, and therefore there would be no catenary wire on Washington Street itself. A bypass lane would be provided at the NEMC stop to allow either an inbound or outbound vehicle to bypass another vehicle at the stop to provide operational flexibility.

4.3.3 Charles Street Alignment/NEMC Portal Alternative

The Charles Street Alignment/NEMC Portal Build Alternative consists of a tunnel that extends south from the Core Tunnel Segment along Charles Street, to a portal located between the NEMC garage and the Doubletree Hotel. The tunnel alignment would be located within the Charles Street ROW in a stacked arrangement, transitioning to a side-by-side arrangement before crossing under Elliot Norton Park south of Warrenton Place, thereby avoiding the homes on Lyndeboro Place. The tunnel then crosses under Tremont Street ascending to a portal in and ramp to grade between the Doubletree Hotel and the NEMC garage where the alignment will connect to Phase I Silver Line service running on the surface along Washington Street. A NEMC surface station would be provided within the Silver Line ROW, just west of Washington Street, as described above.

4.3.4 Stuart Street Alignment/NEMC Portal Alternative

The Stuart Street Alignment/NEMC Portal Build Alternative combines elements of the Charles Street and Tremont Street alignments. This alternative alignment extends from the Core Tunnel Segment at the Boylston Street and Charles Street intersection south along the Charles Street ROW in a stacked tunnel arrangement and a slight upward gradient. The tunnels turn easterly under Stuart Street staying within the ROW in a stacked arrangement. The Silver Line inbound and outbound tunnels begin to transition to a side-by-side arrangement within Stuart Street and are in a final side-by-side arrangement after they turn the corner from Stuart Street south onto Tremont Street. The inbound tunnel gradient increases to approximately 4 percent in Stuart Street and remains constant until increasing again at the portal. The alignment then follows the Tremont Street alignment in a parallel tunnel arrangement, turning east near the NEMC parking garage, where it ramps up at a grade of 5.6 percent passing though BRA and Doubletree properties currently used for parking to a tunnel portal located east of the Tremont Street easterly ROW line. The alignment continues to the east in an open boat section, ending at Washington Street at a point north of the Doubletree Hotel and south of the NEMC garage. A NEMC surface station would be provided within the Silver Line ROW, just west of Washington Street, as described above.

4.3.5 Columbus Avenue Alignment/Columbus Avenue Portal Alternative

The Columbus Avenue Alignment and Portal Build Alternative extends from the Core Tunnel Segment at the Boylston Street and Charles Street South intersection southwest under Charles Street South and Park Plaza within the Columbus Avenue right-of-way in a stacked arrangement, transitioning to a side-by-side configuration prior to the Arlington Street intersection. Continuing westerly, both the inbound and outbound tunnels extend to a portal west of Arlington Street. The

portal would eliminate the two westbound travel lanes of Columbus Avenue between Arlington and Berkeley Streets. The alignment then rises to the surface on a 6% gradient, meeting grade east of the Berkeley Street intersection adjacent to the Salvation Army Headquarters. (See Figure ES-10). A surface stop would be located beyond the top of the ramp for all outbound vehicles. Bus stops would be located on Berkeley Street south of Columbus Avenue for inbound Dudley service and on Columbus Avenue west of Berkeley Street for inbound Back Bay service. All inbound and outbound vehicles would switch from electric to diesel-powered GenSet mode at the top of the ramp, east of Berkeley Street. The catenary would end at Berkeley Street and not continue through the intersection. This portal alternative does not provide the option of a bypass lane at the mode change location for either inbound or outbound vehicles.

4.3.6 Comparative Summary of Portal Alignments

Table ES-2 provides a comparative summary of the portal alignments under consideration for Silver Line Phase III.

Table ES-2 – Comparative Summary of Portal Alignments

Alternative	Portal Location	Length*	Boylston Station	Turnaround Loop***
Tremont Street Alignment/ NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	1,420 feet of tunnel in Tremont Street, plus 840 feet of bypass lane at Boylston Station ** Total: 2,260 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. Bypass lane provided at Boylston Station	Within roadway ROWs at Charles and Boylston Streets. Used for revenue service.
Charles Street Alignment / NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	1,935 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-revenue service.
Stuart Street Alignment/ NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	2,130 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-revenue service.
Columbus Avenue Alignment/ Columbus Avenue Portal	In Columbus Avenue between Arlington and Berkeley Streets- No bypass lane	1,625 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-Revenue Service

* The length of each alignment alternative is measured from the turnaround loop associated with the Core Tunnel Segment at the intersection of Boylston and Charles Streets.

** The configuration of the Tremont Street alignment requires a bypass lane at Boylston Station to allow Silver Line vehicles to change direction at the turnaround loop during revenue service for inbound and outbound service (see Figure 3-4.4). The length of the bypass is included to provide for an equivalent comparison of alternatives.

*** Non-revenue service refers to the bus using the turnaround loop without passengers on board.

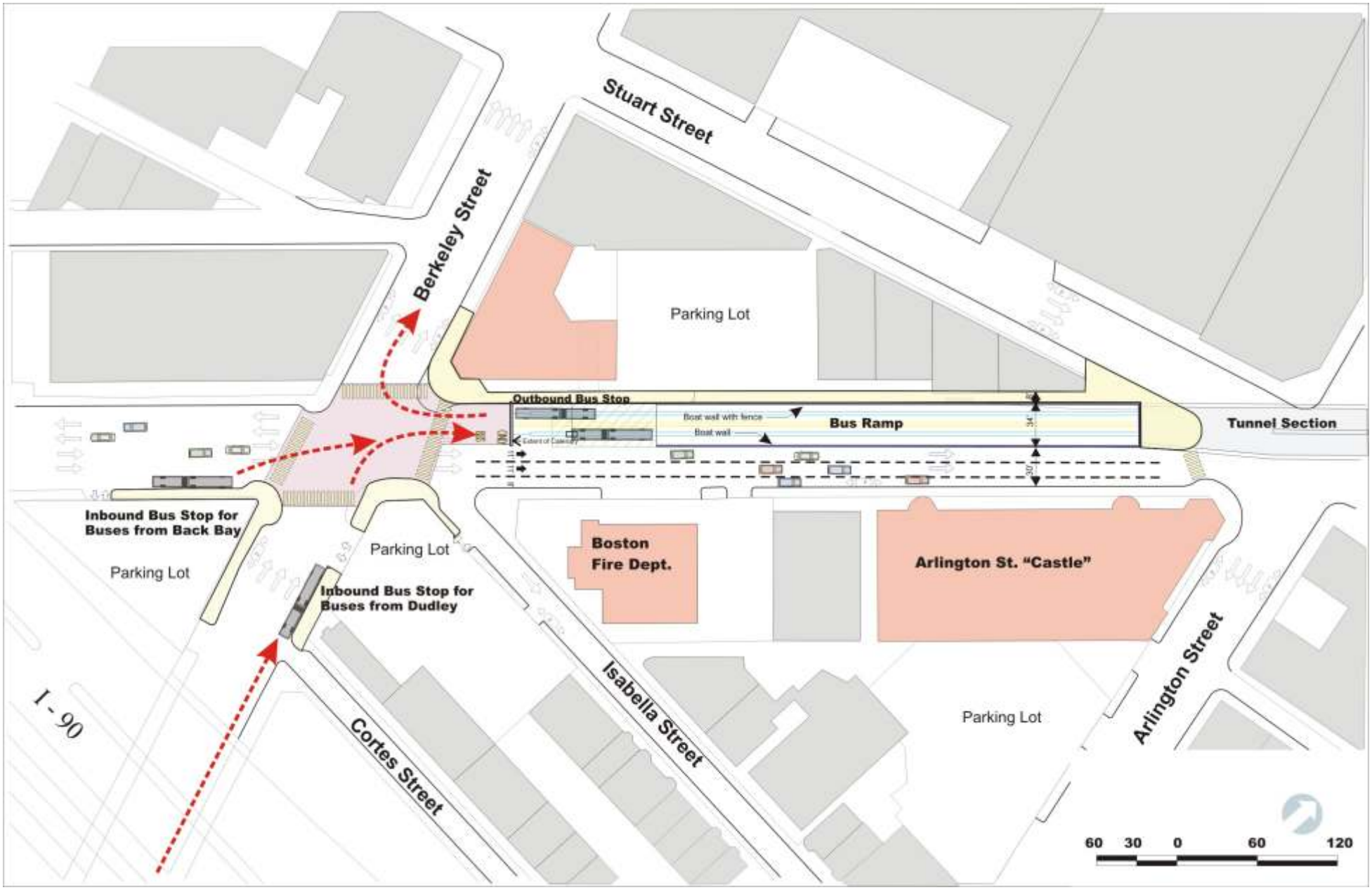

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Figure ES-10
Columbus Avenue Portal

5.0 Operating Plan and Fleet Requirements

5.1 Operating Plan

The No-Build Alternative assumes that Silver Line Phase I and Phase II would remain as separate services, with Phase I operating on 4-minute peak headways, and Phase II operating on 2-minute peak headways.

In the case of the Baseline Alternative, Silver Line Phase I and Phase II would still remain as separate services, but revenue service on both would be increased to a level consistent with that proposed for Phase III operation. Phase I (Dudley Square to Downtown Crossing) peak headways would be decreased from 4 minutes to 3.3 minutes. Phase II peak headways would decrease from 1.3 minutes to 0.8 minutes in the tunnel between South Station and the World Trade Center. A new service from Back Bay to Downtown Crossing would be added. Connections between Phases I and II would be made via a transfer to and from the Red Line at Downtown Crossing Station (to access destinations along Washington Street) and at South Station (to access the Waterfront and Logan Airport).

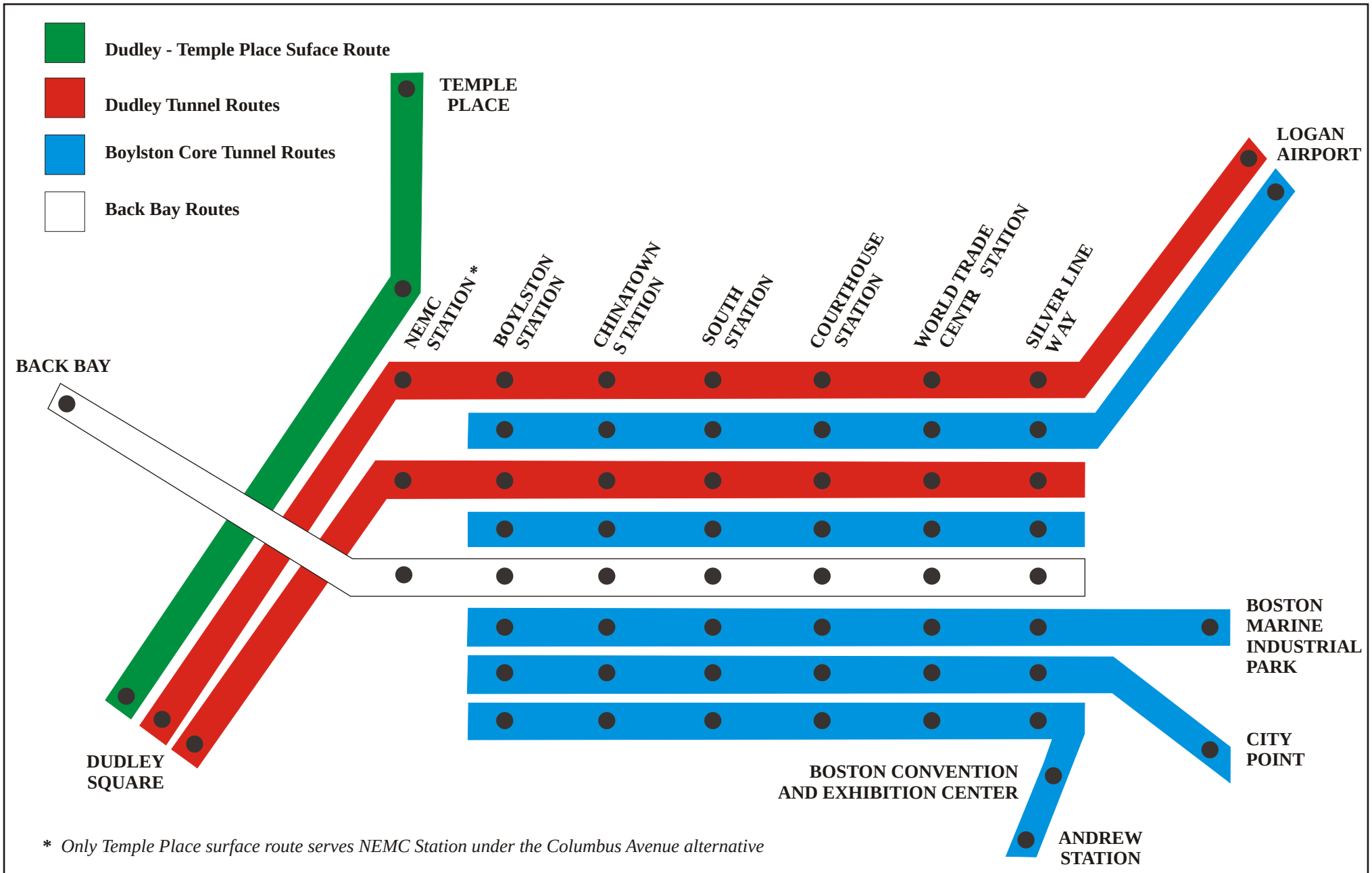
To ensure that the Baseline Alternative is consistent with service proposed for the Phase III Build Alternatives, the same routes and headways are assumed for the Phase I corridor, in the Phase II tunnel, and on surface routes, including a surface route from Dalton Street in the Back Bay to Downtown Crossing.

The operating plan for the Silver Line Phase III Build Alternatives consists of nine routes, of which three originate at Dudley Square, one originates at Dalton Street in the Back Bay, and five originate at Boylston Station. (See Figure ES-11.) This operating plan provides service through the new Phase III tunnel, and maintains one Silver Line surface route via Washington Street between Dudley Square and Downtown Crossing (Temple Place) in response to the existing high ridership on the Phase I service. The Back Bay route will serve anticipated travel demand between Back Bay activity centers (such as hotels) and the new Boston Convention and Exhibition Center (BCEC) in the waterfront area. The operating plan would be the same for either the Tremont Street, Charles Street, or Stuart Street Alignments (connecting to the NEMC Portal), or the Columbus Avenue Alignment and Portal; the only difference is in the surface routes from the respective portal locations to Dudley or Back Bay. Due to the location of the portal, the Columbus Avenue Alternative would not serve the NEMC stop for those routes that utilize the tunnel; however, service to NEMC would be provided via the Dudley to Downtown Crossing service. A description of the Dudley and Back Bay surface routes for each of the portal options follows. Peak-hour headways for the nine routes are as follows:

- Dudley to Logan: 10-minute headway
- Dudley to Silver Line Way: 10-minute headway
- Dudley to Downtown Crossing (Temple Place): 6-minute headway
- Back Bay (Dalton Street) to Silver Line Way: 10-minute headway
- Boylston to Logan: 5-minute headway
- Boylston to BMIP 10-minute headway
- Boylston to City Point: 10-minute headway
- Boylston to BCEC and Andrew Station via D Street: 5-minute headway
- Boylston to Silver Line Way[5]: 3-minute headway

The peak-period levels of service provided on these routes correlate to a Silver Line bus providing service from Dudley approximately every three minutes, a bus from Boylston every minute, and a bus from the Back Bay every 10 minutes.

[5] Formerly known as MassPort Connector Road in South Boston.



* *Only Temple Place surface route serves NEMC Station under the Columbus Avenue alternative*

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure ES-11
Build Alternatives Operating Plan

5.2 Surface Routes

5.2.1 NEMC Portal Surface Routes

The Charles, Tremont and Stuart Street tunnel alignments would all surface at a portal located between the NEMC garage and the Doubletree Hotel. A stop would be provided within the Silver Line ROW at NEMC.

On the Outbound Dudley Route, Silver Line vehicles would turn right onto Washington Street and continue south along the route of the existing Phase I service on Washington Street to Dudley Station. The Inbound Dudley Route also follows Washington Street to the portal. The Dudley to Downtown Crossing route operating on 6-minute headways will remain on the surface, following the same route as the existing Phase I service.

On the Outbound Back Bay Route, Silver Line vehicles would turn right on Washington Street, right on Oak Street and right on Charles Street South, continuing north to Park Plaza. The vehicles would then turn left on Park Plaza and continue on St. James Avenue, bearing left on Huntington to a right on Belvedere Street, and then a right on Dalton Street to a layover stop. The Inbound Back Bay Route would proceed north on Dalton Street, right on Boylston Street, and right on Exeter Street to Stuart Street. From there the vehicle would proceed east on Stuart Street to Arlington Street and Herald Street, turning left on Washington Street and returning to the portal. (See Figure ES-12.)

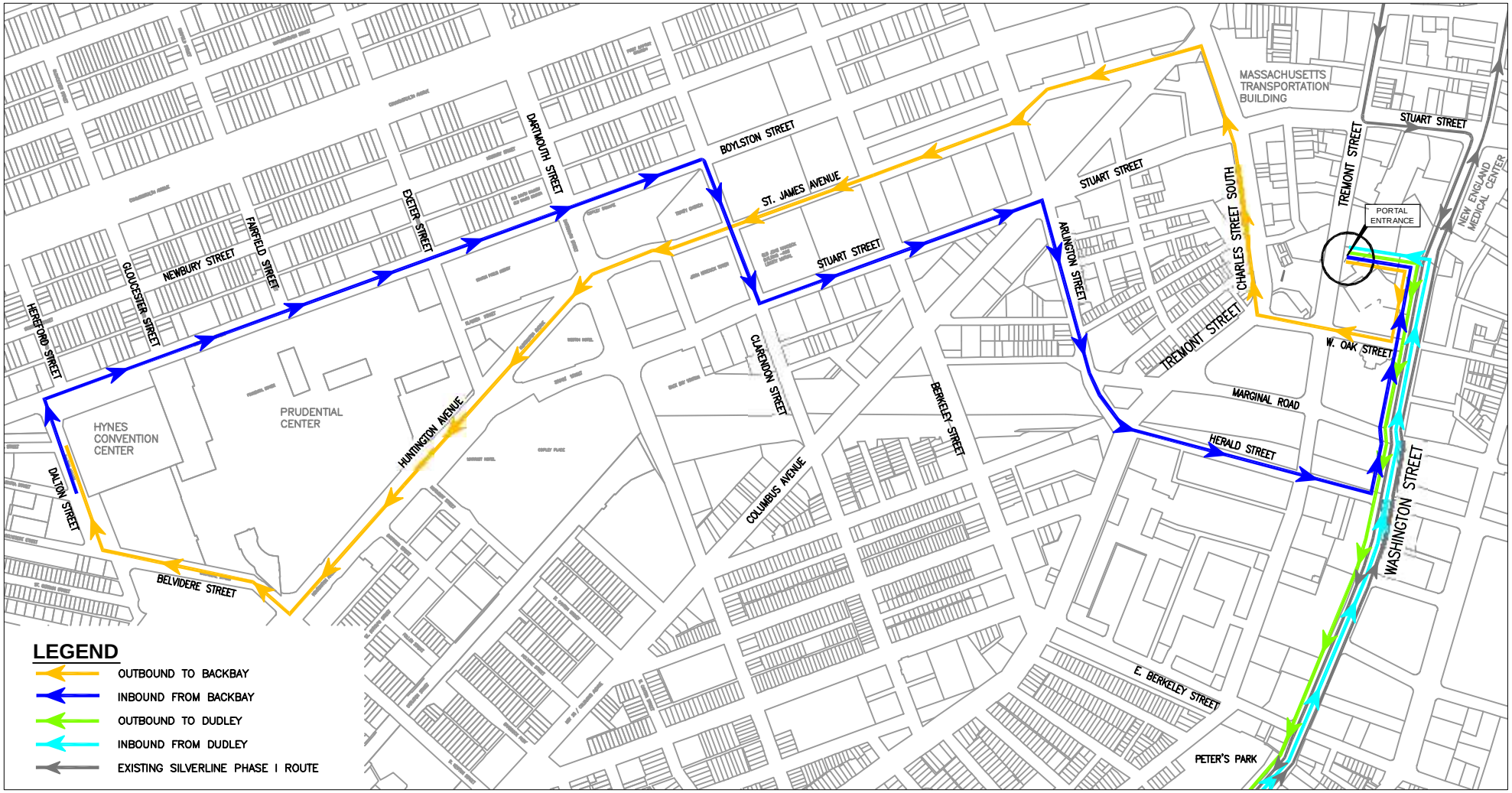
5.2.2 Columbus Avenue Portal Surface Routes

The Columbus Avenue tunnel alignment surfaces at a portal located west of Arlington Street with an outbound surface stop located near Berkeley Street adjacent to the Salvation Army Headquarters building. The inbound portal stops would be located on Berkeley Street south of Columbus for Dudley service and on Columbus Avenue west of Berkeley Street for Back Bay service.

On the Outbound Dudley Route, the Silver Line vehicle would turn right onto Berkeley Street, then follow Stuart, Arlington, and Herald Streets to reach Washington Street. From there the route would continue south along the route of the existing Phase I service on Washington Street to Dudley Station. Improvements to the Herald/Washington Street intersection would be made to facilitate right turns onto Washington Street. The existing Herald Street outbound Silver Line stop would also need to be modified.[6]

The Inbound Dudley Route would follow Washington Street, turn left on East Berkeley Street, and then follow Berkeley Street, turning right on Columbus Avenue to enter the portal.

[6] Note that alternative outbound routing options involving changes in the local street system (e.g., a Berkeley Street contraflow lane to Chandler Street, and/or an exclusive Herald Street bus lane) may provide shorter outbound travel times between the Columbus Avenue portal and the Washington Street corridor. The MBTA has identified a route that is a viable and operationally sufficient, given the current roadway network. It is, however, a somewhat circuitous route and there are opportunities to make it a more direct route that is more along the lines of the Bus Rapid Transit standards. These options, such as adding contraflow lanes, changing street patterns, etc. require significant coordination with the Boston Transportation Department and the neighborhoods. The MBTA will continue to develop these types of options to determine if any are viable, and keep the FTA, EOEA, the City and the public informed of our progress. This SDEIS/EIR is predicated, however, on the routes described above. Any improvements to these routes would have an improvement to ridership and user benefit, but for the purpose of the environmental review, these ridership results would be comparable. These options would be further investigated and described in the final environmental document, should Columbus Avenue be selected as the Preferred Alternative.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure ES-12
NEMC Portal, Dudley and Back Bay Routes

As the route map shows, inbound vehicles entering the Columbus Avenue tunnel would not serve the Herald and the NEMC stops on Washington Street, but they would instead provide a one-seat ride from Dudley to Back Bay/Columbus/Berkeley area, which is not provided with the NEMC portal. This route would also require that the existing inbound East Berkeley Street stop on Washington Street be shifted to a mid-block location on the near side of the East Berkeley/Washington Street intersection.

The Dudley to Downtown Crossing route will remain on the surface, operating on 6-minute headways, and following the same route as the existing Phase I service with inbound and outbound stops at NEMC.

Silver Line vehicles on this proposed Outbound Back Bay Route would turn right on Berkeley Street after the portal stop. The vehicle would then turn left on St. James Avenue and follow the same route as the NEMC portal route to the Dalton Street layover. The Inbound Back Bay Route would also follow the corresponding NEMC route as far as Clarendon Street, where the vehicle would turn right and travel south on Clarendon Street to Columbus Avenue, stopping on Columbus Avenue west of Berkeley Street before entering the Columbus Avenue portal. Note that while the Back Bay Routes for the Columbus Avenue portal are considerably shorter than the corresponding NEMC portal routes, they utilize the same surface stop locations for the on-street portion of the route. (See Figure ES-13)

5.3 Silver Line Vehicle and Fleet Requirements

For the Silver Line Phase III Build Alternatives, the majority of the service would be provided by 60-foot articulated dual mode vehicle that operates in zero-emitting electric mode on catenary in the tunnel, changing to low-emitting diesel-powered (using ultra-low sulfer diesel) GenSet mode on surface routes from the portal to Dudley and Back Bay. However, the Dudley to Downtown Crossing service would continue to use the 60-foot articulated compressed natural gas (CNG) Silver Line Phase I vehicles, as this route operates entirely on the surface.

Table ES-3 provides a summary of the vehicle requirements for each of the alternatives.

Table ES-3 – Fleet Requirements by Alternative

	Dual Mode Vehicles	CNG Vehicles	Dual Mode Vehicles Spares	CNG Vehicles Spares	Total Fleet Requirement
Baseline Alternative					84
NEMC Portal Alternative					
Charles Street	69	8	15	2	94
Tremont Street	70	8	15	2	95
Stuart Street	70	8	15	2	95
Columbus Avenue Portal Alternative					
Columbus Avenue	70	8	15	2	95

Source: IBI, March 8, 2005

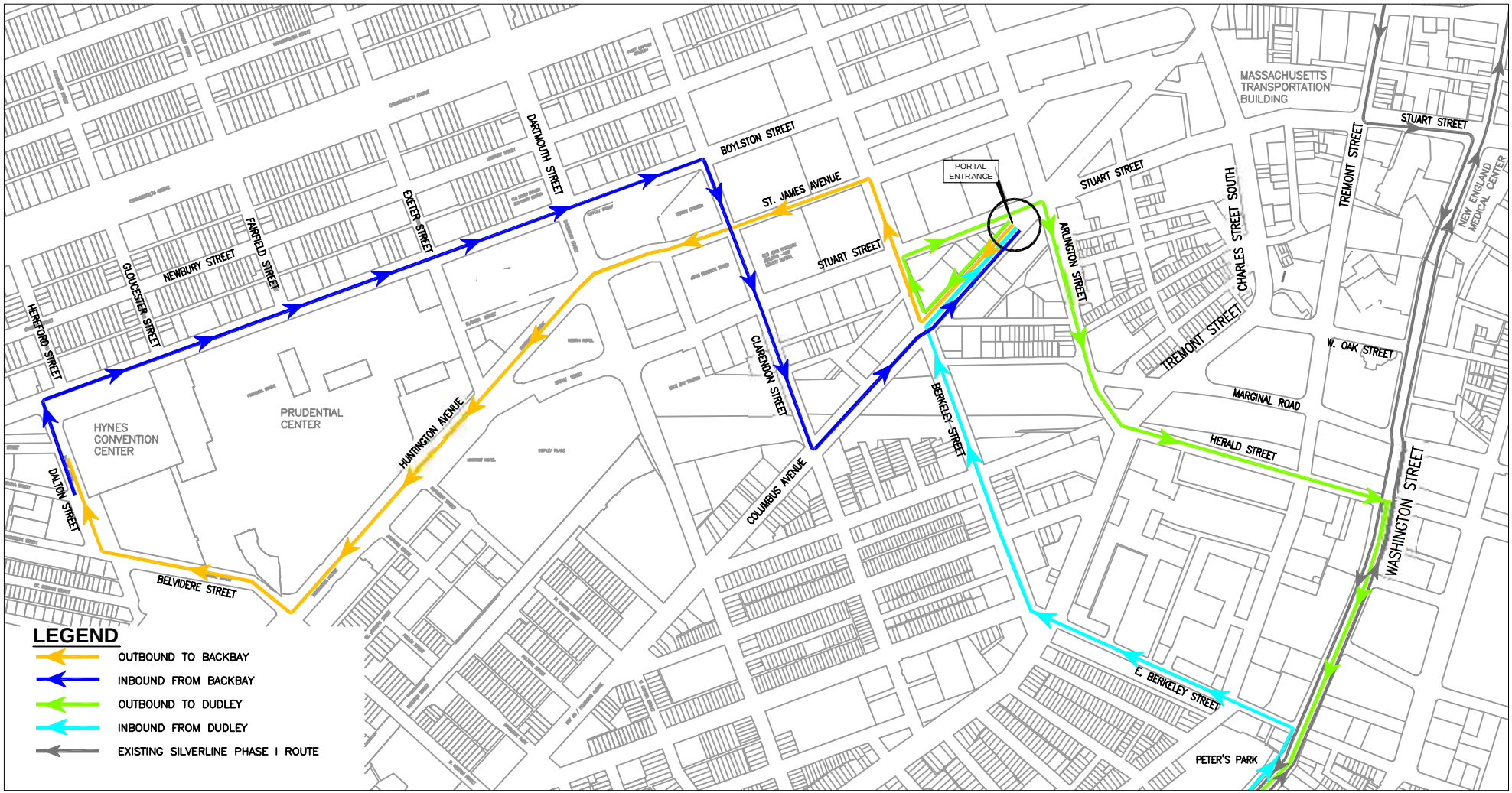


Figure ES-13
Columbus Avenue Portal, Dudley and Back Bay Routes

6.0 Capital and Operating Costs

Capital costs include the cost of infrastructure, such as the tunnels and stations, as well as the costs of acquiring rights-of-way, and of purchasing additional vehicles. Capital costs are expressed in Year-of Expenditure (YOE) dollars and are summarized in Table ES-4.

Table ES-4 – Summary of Capital Costs

	Tremont Street	Charles Street	Stuart Street	Columbus Avenue
Construction	$588.5 million	$559.0 million	$592.9 million	$558.4 million
Soft Costs	$140.9 million	$130.8 million	$140.4 million	$131.0 million
Right of Way	$16.2 million	$ 15.7 million	$ 15.7 million	$ 17.5 million
Vehicles	$62.7 million	$ 62.7 million	$ 62.7 million	$ 64.3 million
TOTAL	**$808.3 million**	**$768.2 million**	**$811.7 million**	**$771.2 million**

Operating costs include the annual cost to operate and maintain the Silver Line service and are presented in Table ES-5 as an incremental cost to the Baseline Alternative service in 2005 dollars.

Table ES-5 – Summary of Operating Costs

	Tremont Street	Charles Street	Stuart Street	Columbus Avenue
Annual Operating and Maintenance Costs	$5.2 million	$5.2 million	$5.2 million	$5.1 million

7.0 Summary of Environmental Impacts

The Silver Line Phase III Core Tunnel Segments and alignment alternatives have been planned to minimize impacts by providing a tunnel design that is within the right-of-way of major streets. This section summarizes the potential environmental impacts and proposed mitigation measures associated with the Build Alternatives so that they may be compared. A comparative summary of the environmental impacts consequences associated with the Core Tunnel Segment and alignment alternatives is provided in Table ES-6 at the end of this section.

7.1 Baseline Alternative

The Baseline Alternative would simply increase the frequency of the Phase I and II service to a level consistent with that proposed for the Build Alternative. To achieve this increased frequency, three vehicles per hour would be added in each direction to Washington Street for Phase I service. The addition of these vehicles to an existing urban street is not anticipated to result in any measurable increase in traffic, air quality, noise, or vibration impacts compared to future No-Build conditions. The increase in Phase II frequency would occur entirely within the existing Phase II tunnel and therefore would not result in traffic, air quality, noise, and vibration impacts to

the community. There are no other short-term or long-term impacts associated with the Baseline Alternative.

7.2 Long-Term Impacts of the Build Alternatives

The Core Tunnel Segment, which is common to all Build Alternatives, would result in minimal long-term impacts, since most of the structures (tunnels and stations) are located entirely underground within existing street ROW. By locating the turnaround loop under the intersection of Boylston and Charles Streets, the Core Tunnel Segment avoids construction on the Boston Common.

The potential for impacts related to the Core Tunnel Segment is largely associated with those project elements that interface with the surface at station areas, such as the structures associated with passenger access, emergency egress and ventilation (see Table ES-6). The Core Tunnel Segment will result in impacts to the Boston Common. The impacts will include parklands, archaeological resources and historical resources. Since these impacts are associated with the Core Tunnel, they will also impact any of the alignments under consideration. The MBTA will work with the Massachusetts Historical Commission (MHC), Boston Landmarks Commission and Boston Parks and Recreation Department as design progresses to ensure compatibility of Silver Line elements with the cultural resources in the corridor. A Programmatic Agreement will be developed to address the elements of the Core Tunnel Segment, as well as the elements of the preferred portal alignment once selected. The agreement will also address the accessibility and fire code requirements related to the existing Green Line station area on the Boston Common.[7] Since Silver Line operations within the Core Tunnel Segment will be entirely underground, there is no traffic issue associated with this segment. Rather, enhancement of the transportation infrastructure will provide a benefit to the existing and future land uses in the corridor, by increasing transportation access and mode choice.

Given that the major portion of the alignment for any of the Build Alternatives is underground in a tunnel, there are relatively few long-term impacts associated with any of the Build Alternatives. Impacts are predominantly associated with the proposed portal locations (NEMC or Columbus Avenue), where the tunnel alignment interfaces with the surface. The following section provides a discussion of the key long-term environmental impact issues as articulated through the public participation process. A summary of all the environmental consequences discussed is provided in Table ES-6. Section 7.3 summarizes construction phase impacts

7.2.1 Tremont, Charles and Stuart Street Alignments/NEMC Portal Issues

The NEMC portal, located between the NEMC garage and the Doubletree Hotel, is associated with the Tremont Street, Charles Street and Stuart Street alignment alternatives. Currently approximately 15 Silver Line vehicles travel on Washington Street in each direction during the peak hour, with an on-street stop near the main entrance of the NEMC. With any of the Build Alternatives using the NEMC portal, the majority of the inbound Silver Line vehicles (18 per hour in the peak) would turn left prior to the crosswalk at the NEMC main entrance and discharge passengers at an off-street stop before entering the tunnel. Outbound vehicles would turn right onto Washington Street after picking up passengers at the portal stop, similarly avoiding the NEMC crosswalk. While overall there is more service under Phase III, there would be less Silver Line vehicles on Washington Street in the area of the NEMC crosswalk, as only the Dudley to Temple Place service would remain on the surface, with a frequency of 10 buses per hour during the peak period (as compared to 12 today). The key long-term impact issues associated with the

[7] These alterations to the Green Line for the purposes of ADA compliance and National Fire Protection Association (NFPA) compliance are identical in all alignment alternatives. No alternative results in different or greater impacts on the Boston Common.

NEMC portal include traffic and pedestrian safety, and potential vibration impacts to NEMC operations.

7.2.1.1 Traffic and Pedestrian Safety

Traffic impact analysis indicates that the Silver Line Phase III project would have a negligible impact to travel times, capacity and congestion within the Washington Street corridor in the NEMC portal area. The most congested intersection within the corridor, Washington Street/ Kneeland Street would experience a slight improvement. This improvement would occur because some of the Silver Line vehicles that currently operate on the surface along Washington Street would instead enter the Phase III tunnel at NEMC, reducing bus volumes at the Kneeland Street intersection.

Concern has been raised regarding potential conflicts between inbound Silver Line vehicles turning to enter the portal and southbound ambulances accessing the NEMC emergency entrance on Nassau Street, opposite the portal. A dedicated 11-foot left-turn lane would be provided along Washington Street for the Silver Line vehicle to facilitate access to the portal. This left-turn would be integrated in the Washington Street design in order to avoid the blockage of the emergency entrance to NEMC at Nassau Street. (See Figure ES-7.) An inbound Silver Line vehicle on Washington Street would utilize this bus-only left-turn land to wait for an opening in southbound Washington Street traffic before turning left to enter the portal.

An analysis of the available gaps in traffic of sufficient duration to allow a vehicle in the opposing lane to make a turn was conducted to determine the potential impact on emergency vehicle access. A gap of 6 seconds is required for ambulances to make a left-turn. Since the Silver Line vehicles are longer, they would require a gap of 10 seconds to make a left turn. The "gap" analysis found that the number of vehicles on Washington Street southbound making a left turn into Nassau Street – 30 (including 4 ambulances) during the morning peak hours and 18 (including 2 ambulances) during the evening peak hours – were considerably less than the number of effective gaps, totaling 140 and 136 in the morning and evening peak hours respectively. Similarly, the number of northbound Silver Line vehicles on Washington Street turning left into the portal (18) is considerably less than the number of available gaps of 6 seconds or more (69 in the morning peak and 52 in the evening peak). Therefore there is sufficient access for emergency vehicles, and the NEMC portal would not impede emergency access to the hospital.

The NEMC portal is located to the south of a number of important pedestrian destinations, including the NEMC and the Orange Line station. Sidewalks on the west side of Washington Street in the vicinity of the portal would be widened, and improvements such as pavement markings, bollards, signs, and audible warning devices would be installed in the vicinity of the portal driveway to enhance pedestrian safety.

7.2.1.2 Noise and Vibration

The noise analysis indicates that there would be no impact to the noise-sensitive receptors[8] in the vicinity of the NEMC portal during operation of Silver Line Phase III. (Construction phase impacts are discussed in a Section 7.3.) Bus related noise levels are expected to be slightly lower at the Doubletree Hotel and NEMC due to the diversion of some of the existing Silver Line surface service as previously discussed.

8 Noise sensitive receptors include the Doubletree Hotel, New England Medical Center, residences on Lyndeboro Place, South Cove Plaza Residences, and Elliot Norton Park.

A detailed analysis of potential vibration impacts at the Tufts NEMC facility indicates that vibration levels from proposed Silver Line vehicle operations – as well as construction of the NEMC portal – would be below allowable vibration levels for sensitive equipment in the clinical labs, operating suite and MRI unit.

7.2.2 Columbus Avenue Alignment/Portal Issues

The Columbus Avenue portal is associated with the Columbus Avenue Alternative. Implementation of this Build Alternative would result in the elimination of the westbound travel lanes on Columbus Avenue between Arlington and Berkeley Streets. Inbound Silver Line vehicles originating in Dudley (12 in the peak hours) would use East Berkeley and Berkeley Streets to access the portal. Outbound Dudley service would use Berkeley, Stuart, Arlington and Herald Streets to access Washington Street. Inbound Back Bay service would use Columbus Avenue to access the portal; the outbound service would use Berkeley Street and St. James Avenue to operate the outbound Back Bay route. The key long-term impact issues associated with the Columbus Avenue portal include traffic and potential groundwater impacts.

7.2.2.1 Traffic

Berkeley Street at the Columbus Avenue intersection is projected to carry approximately 1,464 vehicles in the morning peak hour in 2013, slightly more than the 1,328 vehicles in the evening peak hour. The 12 Silver Line vehicles per hour that would use Berkeley Street (which is already an established MBTA bus route) represent an increase in traffic volume of less than 0.1 percent. While there would be minor changes in delay at this intersection, it would still continue to operate at the same LOS (D) as it would under the 2013 No-Build condition, which is considered acceptable for an urban situation.

The location of the portal on Columbus Avenue and the proposed Silver Line operations are not anticipated to substantially affect operations at the Boston Fire Department station located on the corner of Columbus Avenue and Isabella Street. There is an adequate turning radius in either direction to accommodate the largest piece of fire equipment at the station. The current fire pre-empt signal would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue.

The closure of the westbound travel lanes on Columbus Avenue between Arlington and Berkeley would divert westbound traffic originating in Park Plaza to St. James Avenue and Clarendon Street, where it would rejoin Columbus Avenue. This diversion is expected to increase traffic on Park Plaza/St. James Avenue and on Clarendon Street between St. James Avenue and Columbus Avenue by approximately 350 to 400 vehicles in the peak hour. While this would result in some additional delay at the corresponding intersections, they would continue to operate at an acceptable LOS of D or better, except for the St. James Avenue/Clarendon Street intersection that would operate at an evening peak hour LOS of E.

In addition, approximately 110 vehicles in the evening peak hour currently make a U-turn from Stuart Street onto Columbus Avenue westbound. Under the Columbus Avenue Alternative, this move would be eliminated. Vehicles making this move would either have to travel east, turning left at Charles Street and Park Plaza to continue their westbound travel, or they would turn right on Arlington, Cortes, and Berkeley Streets, with a left-turn on Columbus Avenue to continue westbound. The traffic analysis conducted for the SDEIS/EIR assumed that the vehicles would choose to turn right at Arlington Street. This will add approximately 110 vehicles to Cortes Street (which is one-way westbound) during the evening peak hour, approximately the same number of vehicles that are anticipated being removed from the street as a result of removal of the access from Marginal Street from improvements proposed by the Columbus Center project. The intersection of Berkeley and Cortes Street would operate at LOS of B, both with and without the implementation of the Columbus Avenue alternative. No increase in traffic is anticipated on Isabella Street, which is one-way in the eastbound direction.

The intersection of Arlington/Stuart/Columbus would improve under the Build Alternative. This intersection has had a consistently high accident rate and a poor level of service (LOS E in the morning peak hour and LOS F in the evening peak hour). The closure of westbound Columbus Avenue would eliminate one of the moves at this intersection and improve the LOS to D in the morning peak, and LOS E in the evening peak hour. It also would provide an opportunity to improve pedestrian and vehicular safety at the intersection through roadway layout and signal phasing improvements. The MBTA will coordinate with BTD to obtain signal priority for Silver Line vehicles at study area intersections.

7.2.2.2 Groundwater

Groundwater management is a critical concern for Silver Line Phase III, particularly in areas formed by landfill, such as occurs along the Columbus Avenue alignment. The decay and rot of timber piles due to lowered groundwater levels has been an on-going and widely publicized problem, particularly in the Back Bay, South End and Bay Village neighborhoods of Boston. (The Tremont Street alignment is located within the area of the original Shawmut Peninsula east of Charles Street, while the Charles Street alignment along Charles Street itself appears to be located at the edge of the original peninsula. The Stuart Street alternative appears to be primarily located within the Shawmut Peninsula.)

To address the issue of groundwater levels, the MBTA will install observation wells along the proposed portal alignment to provide a means to collect groundwater data before and during construction and to monitor groundwater levels on a regular basis after construction has been completed. The MBTA will coordinate with the Boston Groundwater Trust on the location of the monitoring wells and upon completion of the project, will turn over the wells to the Trust.

The tunnel will be designed to eliminate any free water leakage and constructed to mitigate as much seepage as possible. Typical post-construction seepage rates through tunnel walls are approximately 1 gallon per minute per 1,000 linear feet of tunnel. Three general waterproofing methods will be used to mitigate seepage: waterproofing membrane around mined tunnels, waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls; and, special detailing at the connection of mined tunnels to tunnels constructed inside slurry walls (cut-and-cover sections).

7.3 Construction Phase Impacts

The tunnel design for all Build Alternatives has been developed to minimize impacts during construction to the greatest extent feasible; the tunnels are within roadway rights-of-way below ground, and in some cases are stacked to avoid adjacent structures and buildings. For the most part, construction of any of the Silver Line Phase III Build Alternatives would result in similar, temporary impacts that would be mitigated through implementation of a Comprehensive Construction Management plan. The Tremont Street Alternative and the Stuart Street Alternative (Tremont Street section), however, present some unique construction issues with the potential for more significant impacts than the Charles Street and Columbus Avenue Alternatives. These alternatives cannot be mined due to the presence of the existing abandoned Tremont Street subway tunnel under Tremont Street between Boylston and Oak Streets, and therefore must be constructed by the cut-and-cover method. The existing tunnel would need to be demolished before the new Silver Line tunnels could be constructed. In addition, the 600 KV line within the existing tunnel that supplies power to the Green Line would need to be relocated prior to any demolition of the tunnel.

Tremont Street is a southbound arterial through the heart of Boston's Theatre District. Cut-and-cover construction will require the closure of the parking lane on each side of Tremont Street and one travel lane, maintaining two travel lanes at all times, causing increased disruption to traffic and abutters during the construction phase. Evening and nighttime construction is typically used

to minimize this type of disruption. However, this approach could not be effectively used here, since much of the activity of the theaters along Tremont Street occurs during the evening hours.

Cut-and-cover construction through Elliot Norton Park for the Charles Street alignment would require that the park be cleared and rebuilt after construction has been completed. The north side of the park is bounded by historic residential structures on Lyndeboro Place that are in close proximity to the proposed tunnel alignment. Noise impacts would be expected at this location during the open cut construction. As a mitigation measure, a 12-foot high opaque privacy screen designed to attenuate dust, noise and views of construction would be erected.

7.4 Mitigation Summary

This section describes the proposed mitigation measures and improvements proposed with the Silver Line Phase III Build Alternatives.

7.4.1 Land Takings and Displacements

Acquisitions of all real property and easements would be completed in accordance with applicable provisions of the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended* and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all business relocations without discrimination.

7.4.1.1 New England Medical Center Portal Property Takings

The NEMC portal would be designed to not preclude future air-rights development above the portal by the BRA. The BRA would be compensated for the ROW taking. No mitigation is anticipated for the taking of property at the Auto Parks Parking business because it is leased from the BRA pending future development of the parcel.

MBTA would work with Doubletree Hotel to reconfigure parking on the parcel to replace the 14 spaces lost, or provide replacement parking in nearby facilities.

7.4.1.2 Columbus Avenue Alternative - Access Impacts

Access to off-street parking and loading docks from Columbus Avenue for the Salvation Army Headquarters Building (155 Columbus Avenue) and Benjamin Franklin Smith Printers (147 Columbus Avenue) that would be lost as a result of implementation of the Columbus Avenue Alternative would be replaced with a new access from Stuart Street. The one-story building at 320 Stuart Street would be removed to create an access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drives.

7.4.2 Traffic

7.4.2.1 NEMC Portal Alternatives

An exclusive left-turn lane for Silver Line vehicles will be provided on Washington Street to manage access to the portal. Additionally, sidewalk and pedestrian safety measures will be installed in the vicinity of the portal.

7.4.2.2 Columbus Avenue Alternative

Proposed intersection improvements at the Arlington/Columbus/Stuart intersection would improve LOS D and also improve traffic and pedestrian safety.

The current fire pre-empt signal operation would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue (westbound fire trucks will be allowed to utilize the available bus lanes).

7.4.3 Pedestrian, Transit, and Bicycle

7.4.3.1 NEMC Portal Pedestrian Improvements

Pavement markings, bollards, signs, lighting and audible warnings will combine to mitigate risks to pedestrians from transit operations. Sidewalks on the west side of Washington Street in the vicinity of the portal driveway opening are currently 13 feet wide and will be widened to 16 feet or more as a parking lane is being removed to increase pedestrian safety.

A pedestrian crosswalk would be located at the portal entrance (west side of Washington Street) in order to facilitate pedestrian movement to and from the bus stop located in the portal. Improvements to the crosswalk in front of the NEMC parking garage ramps will increase pedestrian safety. The roadway in front of the portal and parking garage exits could also be equipped with traffic calming features with the objective of encouraging lower vehicle speeds. Traffic calming features will have to be designed around the needs of emergency vehicles.

An existing, non-accessible pedestrian path connecting Tremont Street to Washington Street through existing parking lots would be replaced with an accessible and lighted path along the side of the NEMC parking garage.

7.4.3.2 Columbus Avenue Pedestrian Improvements

Improvements to the intersection and four street corners of the Columbus Avenue/Berkeley Street intersection would be installed to create a pedestrian-friendly environment. Contrasting pavements would be used through the intersection as a traffic calming measure and to increase driver awareness. Where bus stops are located on three of the five legs of the intersection, well-designed crosswalks, properly timed pedestrian signals, and clear signing would be installed for pedestrian safety and mobility.

7.4.4 Noise and Vibration

No long-term noise or vibration impacts are anticipated; therefore no mitigation is required.

7.4.5 Geology and Groundwater

To address potential groundwater issues, designers will install observation wells along the proposed alignment and at other selected locations near the alignment. These locations will be

determined in coordination with Boston Groundwater Trust. These wells will provide a means to collect groundwater data before and during construction and to monitor groundwater levels on a regular basis after construction has been completed. In addition, the design intent will be to eliminate any free water leakage and to construct the tunnels with as little seepage as possible. Three general waterproofing methods will be used to mitigate seepage: waterproofing membrane around mined tunnels, waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls; and, special detailing at the connection of mined tunnels to tunnels constructed inside slurry walls (cut-and-cover sections).

7.4.6 Water Quality

Stormwater runoff from the boat ramp section associated with either portal location would be intercepted prior to the tunnel portal and routed through a deep-sump catch basin prior to discharge to the City of Boston's storm sewer system. Best Management Practices (BMPs) typical of street maintenance activities such as street sweeping and cleaning of catch basins, as required by the Boston Water and Sewer Commission (BWSC), would be employed to minimize any potential water quality impacts associated with the runoff. In addition, a drainage system would be employed within the tunnel to capture any potential intermittent flows generated from such sources as tunnel structure seepage, vehicle drippings, tunnel washing operations, etc.

7.4.7 Cultural Resources

The MBTA will work with the MHC, Boston Landmarks Commission, and Boston Parks and Recreation Department to develop a process to ensure compatibility of Silver Line elements with the cultural resources in the corridor through design and construction. This process will be spelled out in a formal Programmatic Agreement (PA) signed by all parties. The MOA will also address the accessibility and fire code requirements related to the existing Green Line station area on the Boston Common.

For aboveground resources, long-term visual impacts will be limited to locations of permanent surface elements and will be mitigated by location and design that is sensitive to the adjacent historic resources and meets the Secretary of the Interior's Standards. In addition, survey and National Register evaluation of any additional properties that appear to be more than 50 years old and that have not been surveyed, as well as National Register evaluation of the previously surveyed historic resources, will be conducted under the PA for the preferred alternative alignment corridor.

For archaeological resources, additional archival and geotechnical research to determine the precise horizontal location and vertical depth of archaeologically sensitive strata within the Silver Line Phase III preferred alternative alignment would be conducted. This research would include a review of all soil borings conducted for the project, current underground utility locations, and street widening plans and profiles. The additional research and subsurface testing program(s) would need to be conducted under an archaeological permit issued by the State Archaeologist/Deputy State Historic Preservation Officer, in accordance with the project's PA stipulations for the protection of archaeological resources, including consultation and review by the Wampanoag THPO.

Once a preferred alternative is selected, an intensive (locational) survey would be coordinated with the State Historic Preservation Officer (SHPO), FTA, and MBTA, and undertaken in accordance with the standards of the MHC, the State Archaeologist's permit regulations, the Secretary of the Interior's Standards and Guidelines for Identification, and the National Park Service guidelines for assessing eligibility for listing in the National Register. If resources identified are determined eligible for listing in the National Register, the SHPO would be consulted to determine where any project effects can be prudently or feasibly avoided, minimized, or mitigated. The findings of the above ground and archeological evaluations of the Preferred

Alternative will be presented in the Supplemental Final EIS. This Section 4(f) statement will be circulated with the Supplemental Final EIS.

7.4.8 Parklands

As described above, the MBTA will work with the MHC, Boston Landmarks Commission and Boston Parks and Recreation Department to develop the design of surface elements in Boston Common. In addition the MBTA, in conjunction with the Boston Landmarks Commission, will seek approval from the Massachusetts Department of Public Safety to allow the use of a pop-up hatch instead to an open stairwell as currently proposed to further reduce visual impacts on the Common.

Outside of the proposed structures on Boston Common, there would be no long-term impacts to parklands and, therefore, no mitigation is proposed. Potential construction impacts to Elliot Norton Park (Charles Street Alternative) would be entirely mitigated. Once construction is complete, the parks would be restored to their original condition, with the possibility of additional improvements to their design, landscaping, and facilities.

7.4.9 Visual and Aesthetics

Visual impacts of free-standing structures, catenary and parapet walls would be mitigated through careful attention to architecture design, detailing, materials, security and placement relative to adjacent views and structures.

7.4.10 Safety and Security

Specific safety and security standards will be incorporated into tunnel and station design which promote the safe movement of passengers through the system. Existing MBTA safety practices and procedures would also be implemented to ensure the safety of employees and patrons in stations and on vehicles.

7.4.11 Construction

A Construction Management Plan will be developed to address all aspects of construction including potential impacts and mitigation strategies. A proactive strategy of building and maintaining ongoing dialogue between the MBTA and impacted residents will ensure that construction related issues are efficiently addressed. A multi-tiered community involvement plan will be implemented to provide the best possible experience for each impacted residential community and business. This plan will include working with the City of Boston Transportation Department to prepare a comprehensive Construction Management Plan; coordination with the Boston Groundwater Trust; meeting with affected businesses in advance of construction to discuss the likely impacts and to obtain feedback and respond to questions and concerns generated by the impacted parties; and providing access to a construction liaison to respond to questions and concerns.

Table ES-6 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
Land Use	Underground Easements	None	5,200 sf	Approximately 12,000 sf under Elliot Norton Park.	6,120 square feet	None required.	Approximately 120 square feet directly in front of the Four Seasons Hotel.
	Surface-level impacts: (Potential impacts within street ROW are not listed here.)	None	**Boylston Station** Station access –1,000 sf easement within the Little Building, 74-94 Boylston Street Emergency egress structures: 200-250 sf on Boston Common, adjacent to the Deer Park Maintenance Yard 300 sf of easement within the Walker Building, 120-124 Boylston Street Green Line improvements – 2 elevators at 80-100 sf each and 2 emergency egress shafts at 250-300 sf each all on Boston Common **Chinatown Station** Emergency egress – 300 sf easement could be required within the basement level of the China Trade Building	Land Takings from the Portal: 17,440 sf owned by BRA 5,450 sf owned by the Doubletree Hotel The NEMC portal would not preclude future air-rights development above the portal by the BRA.			Access Impacts from the Portal: 155 Columbus Avenue (Salvation Army) – vehicular access from Columbus Avenue to the parking lot and service entrance would be impeded. 147 Columbus Avenue (Benjamin Franklin Smith Printers) – vehicular access to the loading dock on Columbus Avenue would be impeded; pedestrian access from Stuart Street would remain. 139 Columbus Avenue (Baptiste Yoga) - access to the entrance on Columbus Avenue would be impeded; pedestrian access from Stuart Street would remain. 135 Columbus Avenue (Flash's Cocktails) – vehicular access to the service entrance on Columbus Avenue would be impeded. The primary access to this business is from Stuart Street, which would be unaffected.
	Consistency with Local Plans	Not consistent with the region's long range transportation plan	Silver Line Phase III is a committed project in the region's long-range transportation plan. BRA policies, as expressed in specific plans and its ongoing development review process for the downtown and Waterfront area, encourage the strongest possible relation of development to transit. Silver Line Phase III would be supportive of these plans and policies by providing increased accessibility between key activity centers in the downtown core.				
	Mitigation		*Acquisitions of all real property and easements would be completed in accordance with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all business relocations without discrimination. (See Traffic and Parking for access impacts and mitigation).*				
Environmental Justice	Disproportionate Impacts/Potential Benefits	No impacts. Does not improve access between EJ communities and employment destinations.	Because the Silver Line would be primarily located under ground, there would be minimal impacts to nearby residents and no disproportionate impacts to EJ communities. Silver Line Phase III would benefit EJ communities, improving accessibility to jobs and other major destinations, as a result of travel time savings, improved level of service and greater convenience. It would also provide quicker and more convenient access to important employment destinations in downtown Boston and the Waterfront area.				
Traffic and Parking	Traffic – LOS Analysis Emergency Access	None	No traffic impacts.	No deterioration in LOS at any intersections Gap analysis indicates adequate capacity to accommodate turning Silver Line vehicles and ambulances.			• Improved LOS at the Arlington/ Stuart/ Columbus and Clarendon/Columbus intersection • Acceptable LOS at the Berkeley/ Columbus intersection. • Diversion of traffic to Park Plaza, St. James Avenue, and Clarendon Street with acceptable increase in delay • Deterioration in PM peak hour LOS at St. James/Clarendon intersection (D to E) • Diversion of approximately 110 vehicles to Cortes Street (PM peak hour) • Acceptable PM peak hour LOS at Berkeley/St. James intersection(B to C) and Clarendon/Stuart (C to D) • Adequate turning radius for fire equipment
	Mitigation		*None need*	• *An exclusive left-turn lane for Silver Line vehicles to be provided on Washington Street to manage access to the portal*			*Proposed intersection improvements at the Arlington/Columbus/Stuart intersection would*

Table ES-6 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
				• *Sidewalk and pedestrian safety measures to be installed in the vicinity of the portal.*			*improve LOS D and also improve traffic and pedestrian safety.* *The current fire pre-empt signal operation would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue (westbound fire trucks will be allowed to utilize the available bus lanes).*
	Parking spaces/loading zones/service access lost	No impacts.	No impacts.	• 4 on-street parking spaces along the west side of Washington Street • Approximately 14 off-street parking spaces in the Double Tree Hotel lot • 80-spaces within the Auto-Parks off-street parking lot			12 on-street spaces, loading zones and 2 service driveways at B. Franklin Smith Printers (147 Columbus) and Baptiste Power Yoga (139 Columbus) along the north side of Columbus Avenue between Arlington and Berkeley Streets Metered parking spaces and Clarendon Street Tour Bus Stop along the north side of St. James Avenue between Arlington and Berkeley Streets – peak period only 2 to 3 metered parking spaces along the north side of Park Plaza east of Arlington Street 46 off-street parking spaces within the Salvation Army parking lot Elimination of 2 to 3 on-street parking spaces on Columbus Avenue for inbound Silver Line stop (Back Bay service).
	Mitigation		*None needed*	*No mitigation is required for the taking of property at the Auto Parks Parking Lot because it is leased from the BRA pending future development of the parcel.* *MBTA would work with Doubletree Hotel to reconfigure parking on the parcel to replace the 14 spaces lost, or provide replacement parking in nearby facilities.*			*Access to off-street parking and loading docks from Columbus Avenue for the Salvation Army Headquarters Building (155 Columbus Avenue) and Benjamin Franklin Smith Printers (147 Columbus Avenue) that would be lost as a result of implementation of the Columbus Avenue Alternative would be replaced with a new access from Stuart Street. The one-story building at 320 Stuart Street would be removed to create an access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drives.*
Transit, Pedestrian and Bicycle		None	Increased pedestrian traffic would not negatively affect pedestrian LOS.				
	Mitigation			*Pavement markings, bollards, signs, lighting and audible warnings will combine to mitigate risks to pedestrians from transit operations. Sidewalks on the west side of Washington Street in the vicinity of the portal driveway opening are currently 13 feet wide and will be widened to 16 feet or more as a parking lane is being removed to increase pedestrian safety.* *A pedestrian crosswalk would be located at the portal entrance (West side of Washington Street) in order to facilitate pedestrian movement to and from the bus stop location (in the portal). Improvements to the crosswalk in front of the NEMC parking garage ramps will increase pedestrian safety. The roadway in front of the portal and parking garage exits could also be equipped with traffic calming features with the objective of encouraging lower vehicle speeds. Traffic calming features will have to be designed around the needs of emergency vehicles.* *An existing, non-accessible pedestrian path connecting Tremont Street to Washington Street through existing parking lots would be replaced with an accessible and lighted path along the side of the NEMC Parking Garage.*			*Improvement to the intersection and four street corners of the Columbus Avenue/Berkeley Street intersection would be installed to create a pedestrian-friendly environment. Contrasting pavements would be used through the intersection as a traffic calming measure and to increase driver awareness. Where bus stops are located on three of the five legs of the intersection, well-designed crosswalks, properly timed pedestrian signals, and clear signing would be installed for pedestrian safety and mobility.*

Table ES-6 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
Air Quality	Regional	None	Analysis of air quality at the regional and microscale level have indicated that all of the alternatives would result in a net benefit for regional air quality and not cause any air quality violations at the microscale level.				
	Micro-scale	None					
	Mitigation	*No air quality impacts; therefore no mitigation required.*					
Noise and Vibration	Project-wide/Historic	None	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts
	Vibration at NEMC facilities	None	Not applicable	A detailed analysis of potential vibration impacts at the Tufts NEMC facility indicated that vibration levels from proposed Silver Line vehicle operations as well as construction of the NEMC portal would be below allowable vibration levels for sensitive equipment in the clinical labs, operating suite and MRI unit.			Not applicable
	Mitigation	*No long-term noise or vibration impacts anticipated; therefore no mitigation required.*					
Geology and Groundwater		None	Excessive groundwater seepage not anticipated.				
	Mitigation		*Installation of monitoring wells. Design performance standards and waterproofing would minimize potential for seepage of groundwater.*				
Natural Resources	Wetland, flooding, navigable waterways, ecologically sensitive areas, endangered species, and water quality.	None	No impacts to natural resources.				
	Mitigation		*Water quality impacts would be minimized by the use of Best Management Practices and the design of the drainage system.*				
	Coastal Zones	None	Consistent with Massachusetts Coastal Zone Management (CZM) program policies.	Not within coastal zones.			
	Mitigation			*None needed*			
Cultural Resources	Archaeological	None	10 percent sensitive for significant sites: Native American fishweirs and camps; late 18th c. hemp house; 18th-19th c. domestic site; human burials associated with the Central Burying Ground on Boston Common	95 percent sensitive for significant sites: Native American fishweir and camp site(s); 18th-19th c. domestic/commercial structures and associated yard areas	20 percent sensitive for significant sites, but only in portal area (see common element below)	50 percent sensitive for significant sites: Native American fishweir site(s)	100 percent sensitive for significant sites: deeply buried Native American fishweir (sites)
				19th c. domestic/commercial structures and associated yard areas			
	Mitigation		*Avoidance of archaeologically sensitive areas or data recovery program in advance of construction activities, to be provided for in a Section 106 Programmatic Agreement for cultural resources.*				
	Historic	None	**<u>Total of 60 NR eligible historic resources,</u>** of which 49 will be affected and 11 will not be affected by the project: Permanent surface elements. **<u>Boylston Station</u>** Piano Row National Register Historic District - Emergency tunnel vents/fresh air vents within district The Little Building (NR Listed) - Proposed entry/egress The Walker Building (contributes to Piano Row historic district) - Emergency egress Boston Common (National Historic Landmark, Local Landmark, within the Boston Common and Boston Common and Public Garden National Register Districts) Emergency egress structure Green Line elevator (2) Green Line second emergency egress (2) **<u>Chinatown Station</u>** The proposed access/emergency egress structure could be within the China Trade Building (NR Listed) or within the Liberty Tree Historic District Liberty Tree Historic District - National Register Historic District - Emergency tunnel vents/fresh air vents within district.	Total of 19 NR eligible historic resources, of which 9 will be affected and 10 will not be affected by the project: The alignment crosses Approximately 80 feet of the Tremont Street Tunnel South Extension (NR eligible) would be demolished. Permanent surface elements.	Total of 18 NR eligible historic resources, of which 12 will be affected and 6 will not be affected by the project: Demolish entire Tremont Street Tunnel South Extension. Permanent surface elements.	Total of 13 NR eligible historic resources, of which 7 will be affected and 6 will not be affected by the project: Demolish the Tremont Street Tunnel South Extension from Stuart Street south – approximately 625 feet of the tunnel. Permanent surface elements.	Total of 27 NR eligible historic resources, of which 20 will be affected and 7 will not be affected by the project: - Could be affected by proximity to the portal (see the Land Use Impacts for a description of uses and the Traffic Impacts for a discussion of some of the potential access impacts): 135 Columbus 139 Columbus 147 Columbus 155 Columbus Permanent surface elements.

Table ES-6 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
	Mitigation		*A process to ensure compatibility of Silver Line elements with the cultural resources in the corridor through design and construction will be provided for in a Section 106 Programmatic Agreement for cultural resources.*				
Parklands		None	Boston Common (see historic resources)	Elliot Norton Park - Temporary construction impacts.	None	None	None
	Mitigation		*Work with the MHC, Boston Landmarks Commission and Boston Parks and Recreation Department to develop the design of surface elements in Boston Common will seek approval from the Massachusetts Department of Public Safety to allow the use of a pop-up hatch instead to an open stairwell to further reduce visual impacts on the Common.*	*Park will be restored after the construction period.*	*None needed*		
Visual and Aesthetic Environment		None	Emergency egress structure adjacent to Deer Park Maintenance Facility or within a widened sidewalk on the north side of Boylston Street would have a visual impact.	Components of the portal, especially catenary, and parapet walls and protective fencing, could result in visual impacts.			
	Mitigation		*Extensively mitigated through design and use of high quality materials. See also Parklands Mitigation.*	*Mitigated through design and use of high quality materials.*			
Safety and Security		None	No impacts.				
	Mitigation		*Specific safety and security standards, including those required by the Federal Transit Administration, National Fire Prevention Association, Boston Fire Department and Boston Building Department, will be incorporated into tunnel and station design and existing MBTA safety practices and procedures would be implemented to ensure the safety of employees and patrols in stations and on trains.*				
Energy		None	The project represents a reduction in regional vehicle miles of travel which would result in a net benefit effect on energy use in the region.				
	Mitigation		*None needed*				
Secondary and Cumulative Impacts		None	All analysis has assumed future development projects[9] and anticipated population, employment and land use projections[10] over the next two decades. This information indicates that the Silver Line project is needed to support the transportation demands of future development.				
	Mitigation		*None needed*				

[9] Columbus Center, The Clarendon, Hayward Place.
[10] As forecast by the Metropolitan Planning Area Council and the Boston Redevelopment Authority.

8.0 Comparative Evaluation of Alternatives

This section provides a comparative evaluation of the potential benefits and impacts of the Silver Line Phase III Baseline Alternative and the four Build Alternative alignments – Tremont Street, Charles Street, Stuart Street and Columbus Avenue. The alternatives are evaluated according to the following criteria:

- The ability to satisfy the project Purpose and Need;
- The ability to meet BRT performance characteristics;
- Their potential environmental impacts, both long term and during the construction phase; and
- How they would rate against FTA New Starts criteria.

Generally, a comparative evaluation shows that all four Build Alternatives meet the purpose and need far better than the No-Build or the Baseline Alternatives, and all four would rate well against the New Starts criteria.

When comparing the four Build Alternatives in terms of their ability to meet BRT performance characteristics, it is clear that the Charles Street and Columbus Avenue alternatives better meet the quality characteristics of BRT as explained in Chapter 7. The Tremont Street alternative involves reliability problems because of an at-grade crossing immediately to the east of Boylston Station of the high-frequency bus flows in the Core Tunnel Segment. It also presents a serious passenger comfort problem in requiring the use of the tight radius and steep Charles Street/Boylston Street turnaround loop for revenue service. The other three alternatives have no such crossing movements, and use the turnaround loop only for non-revenue movements. In addition, the Tremont Street alternative requires the use of two additional right-angle small radius curves in conjunction with steep grades, making the Tremont Street alternative the least preferable of the four. Also, the Stuart Street alternative involves three right-angle, tight radius curves, two of them at steep grade; this makes the ride characteristics less consistent with BRT performance characteristics than either the Charles Street or Columbus Avenue alternatives, both of which provide better quality BRT performance characteristics.

In considering the environmental impacts of the four alternatives, again the Tremont Street and Stuart Street alternatives appear less preferable than the Charles Street and Columbus Avenue alternatives. The Tremont Street alternative involves the permanent destruction of most of the historic abandoned Tremont Street subway tunnel. Implementation of the Tremont Street Alternative would require significant cut-and-cover construction in Tremont Street to demolish the old tunnel and build the new one at a lower elevation, causing serious traffic management challenges during construction. The Tremont Street alternative would require additional construction under Boylston Street to accommodate bypass lanes when compared to the other three alternatives causing greater disruption of Boylston Street during construction. Again, this results in Tremont being the least favorable of the four options.

The Stuart Street option also requires destruction of part of the historic Tremont Street structure, with resultant traffic disruption during construction. While it involves less severe impacts than Tremont Street, Stuart Street clearly has greater short-term impacts than Charles Street or Columbus Avenue, so the two alternatives that are superior from a service quality perspective also have less permanent environmental impact. Charles Street does entail the temporary use of Elliot Norton Park, which would require approval of the state legislature under Article 97 of the Constitution of the Commonwealth of Massachusetts, which protects public parks from being converted to other uses. The Columbus Avenue Alternative avoids parklands.

While efforts to develop mitigation strategies for all temporary and permanent impacts are ongoing, it is clear that Charles Street and Columbus Avenue are superior to the Stuart Street and Tremont Street alternatives, both in terms of providing high-quality service to riders and in terms of avoiding or minimizing temporary and permanent environmental impacts.

8.1 Ability to Satisfy the Project Purpose and Need

The goals reflected in the Purpose and Need address the potential transportation benefits of the Silver Line Phase III Alternatives:

- Provide a connection between Silver Line Phase I and Phase II services;
- Enhance connections to existing MBTA rapid transit services;
- Improve mobility and travel times for Boston's residential neighborhoods; and
- Reduce transportation congestion within Boston's Urban Core.

8.1.1 Provide a Connection between Silver Line Phase I and Phase II

The Baseline Alternative would not provide a direct connection between Silver Line Phase I and Phase II services. Passengers using Phase I or Phase II service would either need to transfer to the Red Line or walk to make the connection between the current termination points at Downtown Crossing (Phase I) and South Station (Phase II).

In contrast, all Build Alternatives would provide a direct connection between Silver Line Phases I and II. The Core Tunnel Segment, common to all Build Alternatives, would connect with Phase II, extending from South Station to the federal courthouse and World Trade Center, and BCEC on the South Boston Waterfront. The NEMC Portal Alternatives (Charles, Tremont and Stuart) would connect directly at the portal with Phase I, in operation along Washington Street between Dudley Square and downtown. After exiting the portal on Columbus Avenue and traveling a short distance along surface routes, the Columbus Avenue Alternative would connect with Phase I service on Washington Street at Herald Street for outbound service. The inbound route would leave Washington Street at East Berkeley Street to access the portal. Each alternative would satisfy the project objective for a passenger boarding in Dudley Square to be able to ride on one bus, without transfers, to reach a destination in downtown, the Waterfront or at Logan.

8.1.2 Enhance Connections to Existing MBTA Rapid Transit Services

While the Baseline Alternative would increase the frequency of service on Silver Line Phase I and Phase II and provide a new surface route between Back Bay and Downtown Crossing, no new connections to other MBTA rapid transit services would be created. Connections from Phase I service would remain as they exist today. Passengers would need to transfer from service on a surface route in order to access underground stations at Boylston Street (for the Green Line) or at Chinatown or Downtown Crossing (for the Orange Line). Two transfers would be required to access Silver Line Phase II and the jobs and services of the growing South Boston Waterfront District and the airport.

By contrast, all of the Build Alternatives would provide a direct passenger connection between Silver Line Phase III and existing underground rapid transit services, at the Orange Line Chinatown Station or at the Green Line Boylston Station. The Silver Line Chinatown Station would be located beneath the Orange Line Station, with a direct connection provided via stairways and escalator. The Silver Line Boylston Station would be connected to the Green Line station via a mezzanine level providing a convenient, direct connection between the two transit lines.

8.1.3 Improve Mobility for Boston's Residential Neighborhoods

A major goal of the project is to expand the opportunities for Boston residents located within urban neighborhoods, including Roxbury, Chinatown, Midtown, the Back Bay, and the South End, to access downtown Boston, the Waterfront area, and the Airport. The success of the Phase III alternatives in meeting that goal is measured by the ability of each alternative to attract transit riders through improved service, reduced travel times, and fewer transfers.

Another measure of mobility is quantified in terms of user benefits. User benefits are measured in hours of travel time savings per year for the entire MBTA system; these benefits are calculated by SUMMIT, software created by the FTA and applied to all New Starts projects nationwide to ensure consistency and comparability of results. In accordance with FTA requirements, user benefits for New Starts projects such as the Silver Line are calculated in comparison to a Baseline Alternative.

The ridership forecasts for the Phase III alternatives have been prepared by the Central Transportation Planning Staff (CTPS) using their regional travel demand model set for eastern Massachusetts. This model set meets FTA requirements for forecasting ridership of major transit capital investment projects, like the Silver Line. Forecasts have been developed for the year 2025; they account for changes in land uses and associated trip-making, as well as anticipated improvements to the region's transportation network, independent of the Phase III project, over the next 20 years.

To ensure comparability of results, forecasts for the four Build Alternatives examined in this SDEIS/EIR assume the same general operating plans in terms of the routes to be operated and their headways. Thus, from an operational perspective, the only difference among the alternatives is the portal location at which the Silver Line vehicles will enter and exit the Phase III tunnel in downtown Boston. Since the Tremont Street, Charles Street, and Stuart Street Alternatives, each with a portal at NEMC, have roughly the same route trip times, separate ridership forecasting is not needed for these three alternatives. However, the location of the portal in the Columbus Avenue Alternative necessitates different surface routings, compared to the three NEMC portal alternatives. Therefore, separate ridership forecasts have been prepared for the Columbus Avenue Alternative.

Table ES-7 summarizes the 2025 forecast boardings for the No-Build, Baseline, and the four Build alternatives (as previously noted, the Tremont, Charles and Stuart Street Alternatives have identical results). As shown, implementation of a tunnel connection between Phases I and II of the Silver Line will have a significant impact on transit ridership, with weekday Silver Line boardings increasing by between approximately 165 percent and 176 percent over No-Build conditions if the Phase III tunnel connection was implemented.

Table ES-7 – Silver Line Ridership by Alternative, 2025

Silver Line Boardings	Alternatives			
	No Build[1]	Baseline[2]	Tremont, Charles and Stuart/ NEMC Portal[3]	Columbus Avenue[4]
Average Weekday	58,000	62,517	160,228	153,940
Annual	17,110,000	18,442,515	47,267,260	45,412,300

Source: CTPS
Note:
1. Model run date 4/24/05 – System Wide Ridership
2. Model run date 3/31/05 – System Wide Ridership.
3. Model run date 3/4/05 – System Wide Ridership.
4. Model run date 2/4/05 – System Wide Ridership.

Table ES-8 provides additional detail for each individual Silver Line route in the Build Alternatives. Boardings are totaled in each direction for each of the nine proposed Silver Line routes. (For example, total daily boardings are shown for trips on the route that begins at BMIP and ends at Boylston, as well as in the opposite direction, from Boylston to BMIP). While nominal differences exist by route between the two portal locations, most notably for the route between Dudley and Silver Line Way, these results demonstrate that each proposed route effectively services ridership demand for increased service to and from locations throughout the Silver Line corridor

Table ES-8 – Silver Line Daily Boardings by Route, 2025

Route	Daily Boardings	
	Tremont, Charles and Stuart Alternatives/ NEMC Portal[1]	**Columbus Avenue Alternative[2]**
BMIP-Boylston	4,009	3,886
Boylston-BMIP	6,275	6,031
Boylston – City Point	7,426	7,142
City Point - Boylston	5,784	5,580
Boylston-Silver Line Way	13,926	13,373
Silver Line Way-Boylston	14,440	13,883
Boylston-Logan	9,841	9,464
Logan-Boylston	9,608	9,258
Boylston – Andrew/BCEC	10,172	9,780
Andrew/BCEC – Boylston	9,907	9,540
Silver Line Way-Dalton	4,970	7,197
Dalton-Silver Line Way	5,081	7,189
Silver Line Way-Dudley	10,690	9,483
Dudley-Silver Line Way	9,982	8,749
Downtown Crossing-Dudley	6,756	5,918
Dudley-Downtown Crossing	6,396	5,538
Dudley-Logan	12,466	10,888
Logan-Dudley	12,488	11,043
Total Daily Boardings[3]	**160,228**	**153,940**

Source: CTPS

Note:

1. Model run date 3/4/05.
2. Model run date 2/4/05.
3. Numbers will not add up due to rounding.

Table ES-9 provides the peak hour mode share for trips originating in the Washington Street Corridor and Dalton Street area destined for four key activity centers served by the Silver Line: Financial Center, South Station, Waterfront, and Logan Airport. As shown, the peak period transit mode shares are forecast to increase significantly for each of these key markets served by Phase III.

Table ES-9 – Peak Hour Mode Share

2025 Mode Share		Baseline[1]	NEMC Portal[2]	Columbus Ave Portal[3]
System Wide				
	Person Trips	16,185,200	16,185,200	16,185,200
	Linked Transit Trips	1,161,900	1,176,100	1,173,452
	Transit Mode Share	7.18%	7.27%	7.25%
AM peak period Homebound/ Work trips by area				
Washington Street Corridor to Financial Area				
	Person Trips	1053	1053	1053
	Transit Trips	793	940	933
	Transit Mode Share	75.3%	89.3%	88.6%
Washington Street Corridor to South Station Area				
	Person Trips	370	370	370
	Transit Trips	182	287	267
	Transit Mode Share	49.2%	77.6%	72.2%
Washington Street Corridor to Seaport Area				
	Person Trips	516	516	516
	Transit Trips	379	425	424
	Transit Mode Share	73.4%	82.4%	82.2%
Washington Street Corridor to Logan				
	Person Trips	143	143	143
	Transit Trips	84	90	85
	Transit Mode Share	58.7%	62.9%	59.4%
Back Bay Corridor to Financial Area				
	Person Trips	1,429	1,429	1,429
	Transit Trips	1,186	1,233	1,236
	Transit Mode Share	83.0%	86.28%	86.49%
Back Bay Corridor to South Station Area				
	Person Trips	384	384	384
	Transit Trips	309	354	338
	Transit Mode Share	80.47%	92.19%	88.02%
Back Bay Corridor to Seaport Area				
	Person Trips	581	581	581
	Transit Trips	504	547	507
	Transit Mode Share	86.75%	94.15%	87.26%
Back Bay Corridor to Logan				
	Person Trips	330	330	330
	Transit Trips	286	286	286
	Transit Mode Share	86.67%	86.67%	86.67%
Back Bay Corridor to South Boston				
	Person Trips	111	111	111
	Transit Trips	90	90	90
	Transit Mode Share	81.08%	81.08%	81.08%

Source: CTPS
Note:
1. Model run date- original 6/20/04 (Linked Transit Trips 2/4/05)
2. Model run date - original 9/29/04 (Linked Transit Trips3/4/05).
3. Model run date 2/8/05.

The previous three tables demonstrate that forecast ridership, boardings by route, and transit mode share are essentially the same for the Build Alternatives, regardless of portal location. All Phase III Build Alternatives will provide substantial convenience and travel time benefits for all travel markets served. Each alternative results in a significant increase in transit ridership and each meets the goal of improving mobility and transportation options for Boston communities.

The Build Alternatives improve mobility by providing travel time savings as a result of fewer transfers, reduced in-vehicle travel time, and lessened wait and walk time that are enabled once the Phase III tunnel connects Silver Line Phases I and II.

Many of the largest travel-time savings accrue to some of the most transit-dependent communities in Boston, including residents of Dudley Square and Chinatown. For these two communities, respectively, travel time to the rapidly developing Waterfront area will be reduced by nine to 10 minutes per trip on average for NEMC portal alternatives and eight to nine minutes per trip for the Columbus Portal Alternative. Also notable are the improved travel time benefits for trips originating in the Back Bay and destined to the CBD and Waterfront area, averaging eight minutes per trip.

The Phase III Build Alternatives will allow better and more convenient access and faster trip times to and from key origins and destinations within the Boston area and inner suburbs. By connecting Phases I and II, the Phase III Build Alternatives provide important connections among existing transit lines, creating an interconnected rapid transit system needed to serve growing trip-making demand among key markets.

8.1.4 Reduce Congestion

All of the Build Alternatives are more effective in diverting regional trips from auto to transit (See Table ES-10) compared to the No Build and Baseline Alternatives. The reduction in vehicle miles traveled (VMT) and vehicle hours traveled (VHT) would be similar for all Build Alternatives.

Because of the reduction in VMT, there would be substantial reduction in daily regional vehicle miles of travel, thereby producing region-wide air quality benefits as a result of reduced emissions of nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOCs), compared to the No Build and Baseline Alternatives.

Table ES-10 – Changes in Daily Regional Vehicle Travel and Air Quality from Phase III Operations compared to the No-Build Alternative

2025 Alternative	VMT	VHT	CO (lbs)	NOx (lbs)	VOC (lbs)
No-Build	106,131,900	3,366,200	1,962,909	48,325	47,752
Baseline	-14,400	-600	-220	-0	-0
NEMC Portal (Tremont, Charles, and Stuart Street alternatives)	-43,400	-2,400	-794	-22	-22
Columbus Ave Portal	-46,300	-2,900	-860	-22	-22

Source: CTPS, 2/23/05

8.2 New Starts Criteria

This section describes the New Starts Criteria and associated evaluation measures that the FTA uses to evaluate and rate transit projects nationwide that are seeking federal funding for

implementation. The New Starts program is the Federal government's primary financial resource for supporting locally-planned, implemented, and operated fixed-guideway transit capital investments. Maintaining eligibility for Federal funding is essential for the Silver Line project's cost-effectiveness, given the constraints on the MBTA's capital budget. For this reason, key New Starts measures for each of the Build Alternatives have been calculated for this SDEIS/EIR.

Each year the FTA prepares its Annual Report on New Starts for Congress as a companion document to the annual budget submitted by the President. The report documents recommendations for the allocation of funds under Section 5309 of Title 49 of the United States Code. The Transportation Efficiency Act for the 21st Century (TEA-21) requires that the Annual Report include the evaluation and rating of new or extended fixed-guideway transit projects. The FTA reviews the criteria results for each candidate project and assigns a rating for each criterion. Based on criteria ratings, a candidate project receives an overall rating of either highly recommended, recommended or not recommended. Silver Line Phase III received an overall recommended rating in FTA's Fiscal Year 2006 Annual Report on New Starts to Congress.

Project sponsors are asked to provide the results on specific project measures that respond to each of FTA's New Starts criteria. The measures are derived by comparing the estimated results for the New Start project to those of the Baseline Alternative. For the Silver Line Phase III project, the Baseline Alternative is different from the No-Build because it includes increasing the frequency of service on Silver Line Phases I and II to a level consistent with what would be provided for the proposed Phase III service.

A comparative summary of the Build Alternatives according to their alignment characteristics and key New Starts evaluation criteria is shown in Table ES-11.

9.0 Public Involvement

Under the Silver Line Phase III Public Involvement Program, the Massachusetts Bay Transportation Authority (MBTA) has established the Silver Line Communications and Community Development Office (SLCO) and developed, implemented, and managed a broad-based and comprehensive program of public participation with area residents; businesses; civic and environmental organizations; and government agencies. Public outreach efforts have been ongoing since January 2003 and future efforts will continue in support of selection and implementation of the preferred Phase III alternative and through design and construction. Chapter 8 of the Document provides a detail description the public Involvement Program.

The public involvement strategy for Silver Line Phase III ensures that members of the public are afforded all opportunities to have the most up-to-date information and provide the level of feedback that is a critical component of the alternatives analysis process. To that end, the MBTA has scheduled a substantial number of meetings directly with key stakeholder groups in order to be fully informed of the issues and concerns that are unique to particular neighborhoods that are likely to be impacted by the four alternative alignments presented in this SDEIS/EIR. The MBTA has also designated a liaison person to as a source of contact for the Chinatown community.

During the time frame between January 2003 and April 2005, the MBTA has conducted and coordinated a diverse public involvement program to disseminate information to key stakeholders, and seek input on the Phase III alternatives from members of the impacted communities. This process has included more than 130 meetings with key city representatives, community, business, civic, and institutional groups in the neighborhoods along the alignment study areas, as well as more than 40 meetings, briefings and discussions with elected officials.

The MBTA has prepared a wide variety of informational material for dissemination at community meetings and briefings with elected officials, business, and institutional and civic groups to keep all stakeholders informed and to maintain a consistent flow of two-way communications. The Silver Line Website (http://www.allaboutsilverline.com) and the Silver Line newsletter (DIG It)

have proven to be effective communication tools. Some of the future outreach tools under consideration include: interactive computer presentations and simulations, a project video, and additional brochures available in English and Chinese. A summary of outreach tools that are currently in use for Silver Line Phase III and additional materials that are being developed for future use is provided in detail in Chapter 8 of the SDEIS/EIR.

The SLCO, in coordination with the MBTA Design and Construction Department, will continue to implement the community participation process during design and construction. The MBTA will establish a Phase III liaison position within the MBTA to coordinate with residential communities and businesses on plans for Silver Line construction, including construction techniques, schedules, and anticipated impacts. The liaison will also be available to respond to community concerns both before and during construction activities.

Table ES-11 – Comparative Summary of Build Alternatives

Alternative	Alignment Characteristic			New Starts Criteria					
	Total Length of Travel Boylston Station to Portal (ft)	Running Time [1] Boylston Station to Portal (min:sec)	Running Time [1] Boylston Station to E. Berkeley/ Washington [2] (min:sec)	Daily Ridership	Annual Ridership	User Benefit	Cost-Effectiveness	Mobility Improvements	
				Trips	Trips	Hours	Dollars per hour of travel time savings	Low Income Households within 1/2 mile of stations	Jobs within ½ mile of stations
Tremont Street	3,030	4:33	6:03	160,228	47,267,260	5,449,830	$16.72 (Medium)	4,077	187,154
Charles Street	2,275	2:31	4:01	160,228	47,267,260	5,449,830	$15.96 (Medium)	4,077	187,154
Stuart Street	2,430	3:23	4:53	160,228	47,267,260	5,449,830	$16.79 (Medium)	4,077	187,154
Columbus Avenue	2,175	2:05	4:35 inbound 5:35 outbound	153,940	45,412,300	5,487,295	$15.07 (Medium)	5,118	217,200

Source: CTPS

Notes:

1. Exclusive of mode change and dwell time.
2. The East Berkeley Street/Washington Street intersection represents a common point for all four alignments. A comparison of running times between Boylston Station and this intersection allows for comparison of all Build Alternatives for an equivalent route. Additionally, all travel times from Dudley to this intersection as well as from Boylston to World Trade Center are identical for each alternative.
3. User Benefit is measured in hours of transportation user benefit per year as calculated by SUMMIT, a travel demand forecasting software created by the FTA and required by Congress to be used on all New Starts projects.

CHAPTER 1.0 Purpose and Need

1.1 Introduction

This Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR) describes the alternative tunnel alignments and portal locations for Phase III of the Massachusetts Bay Transportation Authority's (MBTA) Silver Line project. The Silver Line bus rapid transit (BRT) project connects the services provided by the MBTA's South Boston Piers Transitway (EOEA No. 6826), now Silver Line Phase II, and the Washington Street Replacement Transit Service (EOEA No. 11707), now Silver Line Phase I, as well as the Massachusetts Port Authority's (Massport) Airport Intermodal Transit Connector (AITC). The full project, including all phases, is shown in Figure 1.1-1. A Notice of Project Change (NPC) describing the Phase III Silver Line alignment and portal alternatives was submitted to the Massachusetts Executive Office of Environmental Affairs (EOEA), Massachusetts Environmental Policy Act (MEPA) Unit in June 2004; EOEA's Certificate on this NPC was received on August 23, 2004.

By integrating previously separate projects into the Silver Line, the MBTA is improving the service it will provide and is creating substantial new opportunities for people living in Boston's residential neighborhoods, including Roxbury, Chinatown, Midtown, the South End, Back Bay and South Boston, to access the downtown financial district, existing and new development in the South Boston Waterfront area, such as new offices and commercial space, the Federal Courthouse, and the Boston Convention and Exhibition Center (BCEC), and Logan International Airport. Phase III of the project will connect Phase I, in operation along Washington Street between Dudley Square and downtown since July 2002, and Phase II, extending from South Station to the Federal Courthouse, World Trade Center, and BCEC on the South Boston Waterfront. Phase II opened for revenue service on December 17, 2004. The original alignment for the Phase III portion of the Silver Line, extending from South Station along Essex Street, Avenue de Lafayette and Avery/Tremont Streets to a terminus at Boylston Station, was reviewed and approved as part of the 1993 Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR) for the South Boston Piers Transitway project. (A discussion of previous approvals is found in Chapter 2 – *Evolution of Silver Line Alternatives*.)

This combined SDEIS/EIR has been prepared and circulated to satisfy federal and state environmental review requirements for analysis of Phase III alternatives. In accordance with these requirements, this document describes alternatives to the proposed action, the probable adverse effects to the human and natural environments as a result of construction and operation of the Phase III project, and measures incorporated to reduce and mitigate environmental harm and adverse impacts on the surrounding community.

1.2 Description of Proposed Action

As described in this SDEIS/EIR, several alternatives have been developed and evaluated for the Phase III section of the project. The Phase III tunnel section represents the "missing link" between Phase I, now in operation between Dudley Square and downtown Boston, and Phase II, now in operation between downtown Boston and the South Boston Waterfront and Logan Airport. The link that will be provided by Phase III will mean that other links can be made: links between communities, between people and jobs, and between opportunities for growth. In addition, investment in transit in Boston's urban core helps further anchor the city as the economic engine of the region, while providing transportation and environmental benefits by reducing regional automobile

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 1.1-1
Silver Line Full Build

travel and the attendant congestion and air pollution. By completing the entirety of the Silver Line system, Phase III will help reap substantial transportation, environmental, and economic benefits.

The MBTA has identified a core tunnel segment ("Core Tunnel Segment") for Silver Line Phase III that follows an alignment from South Station (where it connects to Phase II) along Essex and Boylston Streets, to a turnaround loop at the intersection of Charles and Boylston Streets, which will allow needed operational flexibility for the Silver Line system. This alignment is a modification of the full build Transitway alignment, which was previously approved along Essex Street, Avenue de Lafayette, Avery Street, and Tremont Street, ending in a turnaround loop beneath Boston Common. (See Chapter 2) The Core Tunnel alignment under Essex and Boylston Streets is straighter than the previous alignment, providing an improved operating environment including potential future conversion to light rail. The relocation of the turnaround loop to the intersection of Boylston/Charles Streets avoids construction on the Boston Common. The Core Tunnel Segment includes two new Silver Line stations at Boylston Street (connecting to the Green Line) and at Chinatown (connecting to the Orange Line). (See Chapter 3 for additional discussion.) This Core Tunnel Segment is common to all of the portal alignment alternatives considered in this SDEIS/EIR; and is substantially similar to the full buildout of the previously reviewed and approved Transitway project.

The following four alternative portal alignments that could complete the connection between Phase I and Phase II service are evaluated in this SDEIS/EIR:

- Tremont Street/New England Medical Center (NEMC) Portal
- Charles Street/ NEMC Portal
- Stuart Street/NEMC Portal
- Columbus Avenue/Columbus Avenue Portal

A complete description of these alternatives can be found in Chapter 3. A summary of other alternatives that were eliminated from consideration through an extensive screening process is provided in Chapter 2.

1.3 Purpose and Need Summary

The purpose of the Phase III project is to physically integrate Silver Line Phases I and II, and provide direct connections to existing MBTA transit services. By connecting Phases I and II, the Phase III project is intended to improve access for growing trip demand to major new regional employment and other opportunities in the South Boston Waterfront area and at Logan Airport. The project will provide direct and efficient connections to other major elements of the regional rapid transit system (the Red, Orange, and Green Lines), thereby improving service and relieving demands on capacity (particularly on the Green Line). The project will serve to reduce transfers and overall travel time for Boston residents located in existing urban neighborhoods in Roxbury, Chinatown, Midtown, the Back Bay, and the South End, providing them with improved rapid transit service to downtown Boston, the Waterfront area, and the Airport, and direct access from residential neighborhoods.

As described in more detail in Chapter 2, the Silver Line project represents the integration of formerly separate transit planning and development efforts in Boston, including improvements needed to serve the emerging South Boston Waterfront area adjacent to Boston's central business district (CBD). Massive development of this area is now underway, bringing significant growth in travel between populations located throughout the Boston metropolitan region and the expanding employment and other trip destinations in the South Boston Waterfront area and Logan International Airport. Build-out of the Waterfront area is projected to increase from the 14 million square feet that were in place in 2000 to 31.3 million square feet by 2025. This growth

is forecast to translate into a 792 percent increase in population and an 82 percent increase in employment (with 18,000 new jobs in the Waterfront area alone).

Achieving full build-out of the Waterfront area is contingent upon implementation of the full Silver Line, including Phase III. Specifically, the Boston Redevelopment Authority's (BRA) *Seaport Public Realm Plan* (1999) established a vision for the Waterfront area that is dependent on completion of the Silver Line to provide transportation access for the new development. As noted in that plan, the Waterfront "will be connected to the…South End and Roxbury through the Silver Line…" Recently completed development as well as future development in the Waterfront area has been approved based on the assumption that the Silver Line will be in place to serve development-related trip-making. For example, the John Joseph Moakley United States Courthouse at Fan Pier was constructed with only 63 parking spaces for its 816 employees and 2,200 daily visitors, relying almost exclusively on the service provided by the Silver Line. Other developments, such as the new Boston Convention and Exhibition Center (BCEC), also assume the implementation of the Silver Line to bring employees and visitors from throughout the Boston region, including downtown and Back Bay hotels. Silver Line Phase III supports this and other new development, by providing key connections to existing MBTA Green and Orange Line services.

In addition to this dramatic expansion in the Waterfront area, growth is also expected within the Phase III corridor itself. Between 2000 and 2025, population in the corridor is expected to increase by 49 percent (from 21,710 to 32,762) and employment is expected to grow by 13 percent. Currently, there are almost 195,000 existing jobs within one-half mile of Phase III stations and this number is expected to increase to over 219,000 by 2025. Growth within the corridor and the Waterfront area will result in significant new trip-making. This new trip making is discussed in more detail below.

1.3.1 Need for Improvements

The need for completion of the Silver Line through implementation of Phase III is based on additional growth in employment and population in an already densely developed and highly constrained portion of downtown Boston. Employment projections developed by the Metropolitan Area Planning Council to the year 2025 for Boston's Urban Core (defined as the Boston peninsula east of Massachusetts Avenue) indicate that in spite of continuing suburban employment growth, the City of Boston will remain the single most important employment center in the 101 cities and towns in the metropolitan Boston area, with 29 percent of the total regional employment opportunities.

Several major commercial projects have recently been completed in the Phase III corridor:

- The Ritz-Carlton Hotel and Towers, a luxury condominium complex with over 300 housing units, a hotel, a health club, and a movie theater, opened in 2001;
- One Lincoln Street in Chinatown, a 952,000 square foot development, consisting of a 37-story office building with 900 underground parking spaces, was completed in 2003;
- The Metropolitan (Parcel C), a mixed-use development with 251 mixed-income residential units with community and retail space located on Nassau Street adjacent to the New England Medical Center, opened in 2003;
- Leather District Lofts, 36 newly converted residential units with an on-site fitness center, opened in 2003 on Beach Street; and
- The Opera House, a newly restored 2,500-seat facility located on Washington Street, diagonally across from the Lafayette Corporate Center, opened in July 2004.

Other major transit trip generators in the Midtown and Chinatown Districts include over 3,000 households with almost 7,000 total residents; several major office towers (20-story 99 Summer Street, 23-story 125 Summer Street, 101 Arch Street, etc.); the City's retail shopping core; the

City's Theatre District (with five major theaters for live performances); the State Transportation Building (housing the State's transportation agencies); educational facilities, including Emerson College which has a full-time enrollment of over 3,500 students; and the Park Plaza area with mid-rise luxury condominiums, hotel, and shopping facilities.

Major transit trip generators within the Chinatown/Leather District section of the Silver Line corridor include the densely populated Chinatown neighborhood and retail/restaurant district; the 95,000 square foot China Trade Center; the New England Medical Center, and six blocks of five- to six-story commercial buildings which have been largely renovated for retail, office, and residential uses in the former leather industry district.

Major transit trip generators in the South Station section of the Silver Line include the recently renovated South Station complex (Red Line transit, commuter rail, Amtrak, and local and intercity buses) with an average daily ridership of over 90,000 passengers[1]; the South Boston Postal annex; the Federal Reserve Bank tower; the 1.5 million square-foot One Financial Center tower; and several other office towers.

Major development projects in the Phase III corridor include the following:

- 500 Atlantic Avenue, a luxury hotel and condominium complex developed by Six Continents Hotels that is under construction;
- Park Essex (formerly Liberty Place), a mixed-use residential and neighborhood commercial development, was given approval by the BRA in December 2002. This new 28 story building will replace three current vacant properties and one surface parking lot, demonstrating a citywide commitment to increasing the residential density in the downtown Boston/Chinatown area. Completion is scheduled in 2006;
- Piano Row, Emerson College's 14-story, 600-bed residence hall and student center on Tremont Street near Boylston Station, scheduled for completion in 2006;
- Loews Boston Hotel, a 432-room hotel project located at the corner of Stuart and Charles Streets, has been approved by the BRA;
- One Charles, a 19-story, 230-unit luxury condominium complex with ground floor retail, opened on Charles Street opposite the Transportation Building at the end of 2004; and
- Columbus Center, a predominantly residential project is located on a seven-acre parcel bordered by Clarendon Street on the west, Tremont Street on the east, Cortes and Stanhope Streets on the north, and the Amtrak rail lines on the south. The project, which has been approved by the BRA, will include approximately 500 residential units (rental, condominium, and affordable), 37,000 square feet of new open space, a 200-room boutique hotel, 50,000 square feet of retail (including a health club, grocery store, daycare center, and café), underground parking for 286 vehicles, and an above-ground parking garage for 633 vehicles. Construction is expected to begin in 2005.

All of this development will add to traffic congestion in the existing, highly constrained roadway network in the Phase III corridor, characterized by its irregular street patterns, narrow rights-of-way, and numerous one-way streets. These conditions will contribute significantly to increased traffic congestion as future development proceeds. Future year forecasts for the one-way eastbound Essex Street, the only major arterial in the Phase III corridor, indicate a traffic demand of over 15,000 vehicles per day (vpd). At their respective intersections with Essex Street, Atlantic Avenue has a future traffic demand of 22,000 vpd, the Surface Artery Southbound will have 15,000 vpd, Washington Street will have 15,000 vpd, and Tremont Street will have 35,000 vpd. These Essex Street intersections are expected to operate with very high volume-to-capacity

[1] Data supplied by Clinton Bench, Central Transportation Planning Staff (CTPS).

ratios, ranging from 0.77 to 1.40 in the p.m. peak hours, with levels of service at or above capacity, and long delays[2]. Without the Phase III tunnel, these delays would only be made worse. Relatedly, air quality commitments in the State Implementation Plan as well as commitments in the Administrative Consent Order for the Central/Artery Project which specifies implementation of the full Silver Line project would not be met. Finally, Phase III of the Silver Line meets key sustainable development principles identified by the Massachusetts Office for Commonwealth Development, including increasing access to transportation options and investing in transportation infrastructure that encourages smart growth.

Furthermore, the Silver Line corridor also contains some of the most transit-dependent populations in Boston. Within one-half mile of the Phase III stations over 50 percent of households do not own automobiles, and 20 percent (2,000 households) are low income.

Completion of the Silver Line is needed to serve existing and projected development throughout the corridor, improve mobility options for Boston's residential neighborhoods by improving travel times, reducing transfers, and connecting to existing transit lines, relieve capacity constraints on existing MBTA transit lines, particularly the Green Line, and at heavily utilized stations such as Park Street, Downtown Crossing, and South Station, and support the continued vitality of Boston's Urban Core by reducing congestion and enhancing the human and natural environments.

1.4 Objectives and Requirements of this SDEIS/EIR

This SDEIS/EIR is a combined federal and state document prepared to satisfy the requirements under the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) identifying the environmental impacts of the Phase III project. The SDEIS/EIR is also intended to satisfy federal and state environmental justice requirements, as well as the requirements of Section 4(f) of the Department of Transportation Act of 1966 relating to the use of parklands for transportation projects and Section 106 of the National Historic Preservation Act of 1966 relating to preservation of historic resources.

This document has been prepared in accordance with EOEA's August 2004 Certificate (see Attachment A), which identifies the range of alternatives considered for Phase III of the Silver Line, and the scope of potential impacts to the human and natural environments to be analyzed. A Notice of Intent to prepare this document was published in the *Federal Register* on June 28, 2004, and the Federal Transit Administration (FTA) concurred with the scope detailed in the EOEA Certificate in a letter dated December 8, 2004.

Through this SDEIS/EIR, the MBTA is seeking public input on the Phase III alternatives under consideration. That input will be used to support selection by the MBTA of the preferred alternative for implementation. A Supplemental Final EIS/EIR will identify the preferred alternative and respond to substantive comments received on this draft document.

1.5 Organization of Document

This SDEIS/EIR is divided into the following:

- Volume I, main report text, graphics and attachments (including the EOEA Certificate and proposed Section 61 findings);
- Volume II, Response to Comments on the Notice of Project Change; and

[2] Central/Artery Tunnel project data.

- Volume III, Technical Appendices

Volume I of the SDEIS/EIR document is organized as follows:

Chapter 1.0 describes the purpose and need for the project and provides a summary of how the document is organized.

Chapter 2.0 describes how the project evolved and provides a summary of the screening process through which other alternatives were eliminated from consideration.

Chapter 3.0 provides a description of the alternatives considered in the SDEIS/EIR, including a discussion of costs and operating plans for each of the alternatives.

Chapter 4.0 describes existing conditions along each Phase III alternative corridor.

Chapter 5.0 describes the long-term environmental consequences and proposed mitigation for each of the Phase III alignment alternatives compared to the No-Build Alternative.

Chapter 6.0 describes the anticipated construction methodology and mitigation measures associated with construction of the Phase III project.

Chapter 7.0 provides a comparative evaluation of the alternatives.

Chapter 8.0 documents the extensive public participation and consultation that has occurred throughout the development of the Phase III project.

Chapter 9.0 describes the sources of funds that would be used to implement Phase III and the financial feasibility of the Build Alternative.

CHAPTER 2.0 Evolution of the Silver Line Phase III Alternatives

2.1 Introduction

This chapter summarizes the Massachusetts Bay Transportation Authority's (MBTA's) extensive process of developing and screening alternative alignments and portal options for the Silver Line Phase III project. The chapter begins with a summary discussion of the original project alignment presented in the 1993 *South Boston Piers/Fort Point Channel Transit Project Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR).* This chapter then describes the subsequent evolution of the Silver Line Phase III alignment, including a discussion of the screening criteria that led to the elimination of certain alternatives and the selection of the alternatives currently described and analyzed in this *Silver Line Phase III Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR)*. A complete summary of the history of the environmental review process for the overall Silver Line project and its predecessor projects, the South Boston Piers/Fort Point Channel Transitway and the Washington Street Replacement Service, was presented in the *4th Annual Update Pursuant to M.G.L. Section 61* in February 2005. A copy of the Annual Update can be reviewed via the MBTA website at http://www.allaboutsilverline.com/annualtext.asp.

Phase III of the Silver Line incorporates what had originally been the second phase of the South Boston Piers Transitway: a tunnel connection between South Station and Boylston Station, providing transit connections to the Red, Orange and Green Lines. The original alignment for this phase, extending from South Station along Essex Street, Avenue de Lafayette and Avery/Tremont Streets to Boylston Station terminating in a loop underneath the Boston Common in the Vicinity of the Central Burying Ground, was reviewed and approved as part of the 1993 FEIS/FEIR. The Secretary of the Massachusetts Executive Office of Environmental Affairs (EOEA) issued its FEIR Certificate on February 16, 1994, which completed state-level Massachusetts Environmental Policy Act (MEPA) review, and the Federal Transit Administration (FTA) issued its Record of Decision (ROD) for the Full Build Transitway Project on May 12, 1994, which completed federal National Environmental Policy Act (NEPA) review. A Process Memorandum of Agreement (MOA) was also executed with the Massachusetts Historical Commission (MHC), containing the MBTA's commitments to mitigate impacts to historic and archaeological resources.

In 1997, the Massachusetts Port Authority (Massport) modified their ground access plans, dropping the previously proposed People Mover and Logan Terminal to South Station shuttle, and substituting the Airport Intermodal Transit Connector (AITC), permitting a one-seat ride from Logan terminals to the South Boston waterfront, South Station, Chinatown Station on the Orange Line, and Boylston Street on the Green Line via the South Boston Transitway (now called Silver Line). FTA approved the Massport document in 1997.

The MBTA subsequently proposed the integration of the Washington Street Replacement Service (now Silver Line Phase I) and Transitway projects (now Silver Line Phases II and III) into the combined Silver Line in the *Washington Street/Silver Line Transit Service Environmental Notification Form (ENF),* filed with EOEA for review under MEPA in July 1998. On August 21, 1998, the Secretary of EOEA issued a Certificate that allowed the MBTA to prepare a Notice of Project Change (NPC) to address issues raised in both the Certificate and the ENF comment letters relating to the full Silver Line project. In response, the 1999 *Notice of Project Change, Washington Street/Silver Line Transit Service and Roadway Improvements; Response to Comments, South Boston Piers Transitway* formally presented a description of the combined

Silver Line, including the Phase III element analyzed in this document. On August 9, 1999, the Secretary of EOEA issued a Certificate requiring the MBTA to prepare annual informational updates on the Silver Line. The Certificate also required an evaluation of any additional environmental impacts associated with the extension of the Phase III tunnel to a proposed portal on Washington Street.

The MBTA has continued to develop Silver Line Phase III since the 1999 NPC, as it has advanced the design for the project into preliminary engineering. During this process, the MBTA has continued to refine the alignment to avoid impacts to important cultural and community resources (such as the Boston Common and the Chinatown YMCA), to satisfy design, construction, and operational criteria, and to maintain ridership demand while reducing the overall cost of the project so as to make it more competitive for federal funds. Section 2.2 of this chapter describes the criteria used by the MBTA in evaluating and screening alternative alignments. Section 2.3 then describes the evolution of different alternatives and the results of the screening process, leading to the selection of the alternatives under analysis in this document.

The process leading to the development of the Build Alternatives under consideration in this SDEIS/EIR has conscientiously followed recommended planning practice and Federal procedures. The MBTA has given serious consideration to public comments and coordinated with local elected officials. Efforts have been made to conform with local plans and avoid adverse impact on community, historic and parkland resources, as required by Federal law. The MBTA has adopted or accommodated a number of suggestions developed through an extensive public process in whole or in part. This public process, initiated in 1999, has resulted in substantial evolution and improvement of the options for Silver Line Phase III, leading to the four Build Alternatives presented in this SDEIS/EIR.

2.2 Criteria Used in the Screening Evaluation of Alternatives

Since completion of the 1993 FEIS/FEIR for the South Boston Piers Transitway, the Silver Line Phase III alignment has been modified to minimize impacts to important cultural and community resources; respond to design, construction, and operational considerations; meet ridership demand related to the project purpose and need; and reduce the overall cost of the project to make it more competitive for Federal funds. This section provides a discussion of the criteria that were considered in the evolution and screening of alignment alternatives, which led to the selection of alternatives to be considered in the SDEIS/EIR. These are the same criteria that must be applied under Section 4(f) of the Transportation Act of 1966 review, to determine if an alternative is infeasible (for technical or economic reasons, or because it fails to satisfy project purpose and need) or imprudent (because it involves unacceptably high impacts on parklands, historic resources, community facilities, or other resources). (See Section 5.10 for additional discussion of Section 4(f).)

As indicated in Table 2.3-1 at the end of this chapter, common elements of the alternatives emerged as design solutions to these criteria were developed, leading to the development of the Core Tunnel Segment for much of the Phase III alignment. This segment extends along Essex and Boylston Streets between South Station and the turnaround loop beneath the intersection of Boylston and Charles Streets. As a result of this extensive evaluation and screening process, the issues that remain to be considered within the context of this SDEIS/EIR relate primarily to the consideration of a limited number of alternatives for the Silver Line Phase III alignment from the turnaround loop to the portal, providing the connection to Phase I service.

2.2.1 Impacts on Community, Parkland, and Cultural Resources

One important criterion influencing the development of alignment alternatives has been the potential for adverse impacts on community, parkland, or cultural (historic and archaeological) resources. Specific resources considered under this criterion include the Chinatown YMCA, the

Boston Common, and Elliot Norton Park, based on community and agency comments. (See Chapter 4 for more information on these resources.)

As discussed in Section 2.3.3, the Silver Line Phase III alignment presented in the 2002 *2nd Annual Update Pursuant to M.G.L. Section 61* would have provided an operational connection to the Silver Line Phase I service via a tunnel portal and ramp to the surface at Washington Street within the site of the Chinatown YMCA. The YMCA would have needed to be demolished and relocated to a new off-site location under this alternative alignment. As described in Section 2.3.4.1, this portal location has been eliminated in favor of an alternate location between the New England Medical Center (NEMC) garage and the Doubletree Hotel which is currently occupied by surface parking (the "NEMC" portal, which is associated with the Tremont Street, Charles Street, and Stuart Street alignment alternatives evaluated in this SDEIS/EIR). The NEMC portal provides a similar operational connection to Phase I service without the adverse impact associated with demolition of a community center.

The Boston Common, established in 1634, is the oldest public park in the United States and is listed on the National Register of Historic Places as a National Historic Landmark. It has also been designated as having high sensitivity for both contact and pre-contact archaeological resources. (See Chapter 4 for additional information.) While the MBTA received approval for the 1993 Transitway alignment (See Section 2.3.1), which included a turnaround loop and Boylston Station under the Boston Common, more recent discussions with the City of Boston Parks and Recreation Department, the Boston Landmarks Commission, and the Massachusetts Historical Commission indicated a concern regarding the potential for adverse impacts to the Boston Common from installation of an access shaft to support construction of the underground tunnel loop and station beneath the Common. As described in Section 2.3.4.3, an alternate design concept was developed that avoided these impacts by placing Boylston Station beneath the right-of-way of Boylston Street and providing a turnaround loop beneath the intersection of Boylston and Charles Streets. All alternatives that included a station and turnaround loop under the Boston Common were eliminated in favor of this alternate design concept, which is now part of the Core Tunnel Segment.

Finally, Elliot Norton Park has been identified as a parkland resource, with particular significance for the Bay Village neighborhood. As described in Section 2.4, the Charles Street alignment with a portal at Elliot Norton Park, was among the alternatives presented in the June 2004 *Notice of Project Change* submitted to the EOEA proposing modifications to the Phase III segment of the Silver Line. It has been eliminated from further consideration as a SDEIS/EIR alternative because it would have required the permanent taking of the park. The Charles Street alignment with a NEMC portal would create temporary construction phase impacts at the park and is under consideration as a SDEIS/EIR alternative. The park would be fully restored after construction. (See Chapter 6.)

2.2.2 Technical Feasibility: Design, Engineering, and Construction Standards

Since the early stages of planning and design of the Transitway project (the predecessor to the Silver Line), the MBTA has maintained a standard for Bus Rapid Transit (BRT) design, construction and operation (see Section 7.3 for a more detailed description of Silver Line BRT performance characteristics). The standards require, among other criteria, that the project must be designed to allow future potential conversion to light rail. These design standards affect such areas as grade, elevation, radii of curves, *etc.* The MBTA is planning to maintain this standard throughout Phase III. All alternatives considered must comply with these design standards.

One issue of particular significance to the evaluation of Silver Line alignment alternatives is the maximum grade of the travel way. The steeper the grade, the greater is the power demand and the wear and tear on the vehicle, and the higher the likelihood that the vehicle will fail and cause delays in the system. Steeper grades also result in higher capital costs for traction power

infrastructure and for vehicles built to cope with more demanding operating conditions. As a result, the MBTA established a maximum preferred grade of 5 percent for the Silver Line in 1993, with an absolute maximum of 6 percent under specific circumstances. These design criteria were established to allow for a future conversion to light rail. In addition, the Silver Line Bus Rapid Transit (BRT) dual mode vehicle has been designed to operate at a maximum grade of 6 percent. As further described in Section 2.3.4.3, Tremont Street alignment alternatives that include a single mid-block station between Chinatown and Boylston Station instead of separate Boylston and Chinatown Silver Line stations fail to satisfy this criterion of technical feasibility.

2.2.3 Operational Considerations and Ridership Demand

Transportation modeling for Silver Line Phase III indicates very high passenger demand in the Core Tunnel Segment between South Station and Boylston Station. This is an important segment of the Silver Line, providing connections to the MBTA's Red, Orange, and Green Lines. The service plan for Silver Line Phase III (see Chapter 3) provides a high service frequency and passenger capacity within the Core Tunnel Segment to serve the high passenger demand between the downtown core and the South Boston Waterfront, consistent with the project purpose and need described in Chapter 1. The service plan operates eight of the Silver Line's nine routes within the Core Tunnel Segment, with peak headways of less than a minute to serve this demand.

To adequately meet this demand approximately three out of four vehicles will be "short-turned" after the Boylston Station for a return inbound trip towards the waterfront. The Boylston Loop allows short-turning vehicles to complete this movement in the quickest possible fashion, so that vehicles may be re-entered into revenue service in the opposite direction of travel, thereby minimizing operating costs and vehicle fleet requirements. The Boylston Loop also allows the movement to be completed within a dedicated right-of-way free of non-transit traffic, and without requiring a mode change, which is required at the surface. Due to its physical location in the midsection of the high passenger demand segment between Boylston Station and the South Boston Waterfront, rather than at the end, a retrofit of the existing Phase II turnaround loop at South Station would be of no operational use to the short-turned vehicles serving the high demand stations between Boylston Street and the South Boston Waterfront. As further described in Section 2.3.4.3, alternatives that exclude a turnaround loop fail to satisfy this key criterion.

Travel demand and ridership levels for the Silver Line Phase III are significantly affected by access time to stations, passenger travel times within the system, and the ability to maintain vehicle headways. As further described in Section 2.3.4.3, Tremont Street alignment alternatives with a single mid-block station fail to satisfy the criterion of maintaining ridership levels because of longer access times, longer trip times, and longer dwell times that would exceed the vehicle headways, resulting in unacceptable service delays and vehicle queues throughout the system.

2.2.4 Cost Effectiveness and Eligibility for Federal Funding

The cost effectiveness of the Silver Line Phase III project alternatives is key to obtaining federal funding under FTA's Section 5309 New Starts program. Projects seeking New Starts funding must make annual submittals to FTA detailing the proposed project's justification and costs. Project justification is determined by equal weights placed by FTA on cost effectiveness and transit-supportive land use[1]. Cost effectiveness is calculated according to FTA guidance by

[1] The MBTA has consistently received a high rating from FTA on its transit-supportive land use. In addition to the two key New Starts criteria, there are other project justification criteria reported to FTA: mobility, operating efficiencies, and environmental benefits. These other criteria are typically considered in a project justification rating only in cases where an overall project justification is on the cusp of two rating categories.

dividing the annualized capital and operating costs of each alternative by the annual travel time savings enjoyed by new and existing riders of the transit system; these travel time savings are referred to as "user benefits". In March 2005, FTA determined that projects must receive a cost effectiveness rating of medium or better to be eligible for New Starts funding. Because federal funds are needed to implement the Phase III project, the alternatives must be evaluated on both overall costs as well as user benefits. Any alternative that cannot achieve a cost effectiveness rating of medium or higher will not be considered by the MBTA.

2.3 Chronology and Description of Alternatives

The following section summarizes the evolution and screening of the alignment alternatives for Phase III of the Silver Line, beginning with a summary discussion of the original project alignment presented in the 1993 FEIS/FEIR. Table 2.3-1, at the end of the chapter, provides a comparative summary of the alternatives considered. A more detailed discussion of these alternatives was presented in the *3rd Annual Update Pursuant to M.G.L. Section 61* filed with EOEA in December 2003. The 2003 *3rd Annual Update* is hereby incorporated by reference.

2.3.1 1993 FEIS/FEIR Alignment

The tunnel alignment for the Silver Line from South Station to Boylston Street was originally proposed along Essex and Avery Streets, documented in the 1993 FEIS/FEIR for the South Boston Piers Transitway. (This alignment is shown in Figure 2.3-1.) The 1993 FEIS/FEIR alignment, which was designed to provide direct connections to the Green and Orange Lines, extended in a tunnel from South Station west along Essex Street, Avenue de Lafayette, Hayward Place, and Avery Street. A new underground station was proposed near the intersection of Washington Street and Hayward Place at which transfers could be made to Chinatown Station on the Orange Line via a pedestrian tunnel. From there, the alignment continued west along Avery Street to a new station and platform one level below the existing Green Line Boylston Station platforms. A tunnel loop was proposed in the vicinity of the Central Burying Ground on the Boston Common to allow the vehicles to reverse direction to South Station. There was no portal to surface proposed as part of this alternative; the entire alignment was in a tunnel.

The FEIS/FEIR alignment received a ROD from FTA under NEPA, and a final Certificate from EOEA under MEPA, concluding environmental review and approving this alignment in 1994. Furthermore, the MBTA negotiated and executed an MOA with the MHC and the FTA pursuant to Section 106 of the National Historic Preservation Act for the FEIS/FEIR tunnel loop under Boston Common in the vicinity of the Central Burying Ground.

2.3.2 1999 Notice of Project Change Alignment

The 1999 NPC established Phase III of the Silver Line, allowing a connection between Phase I, with service on Washington Street between Dudley and Downtown, and Phase II, providing service between South Station, the South Boston Waterfront area, and Logan Airport. The NPC alignment included the approved Avery Street alignment, as documented in the 1993 FEIS/FEIR, serving as the core tunnel segment of Phase III. Phase III then continued in a tunnel alignment extending south along Tremont Street to the Chinatown YMCA, where the tunnel turned east to a portal on Washington Street, just north of the intersection with Oak Street. A new underground Silver Line Station connecting to the Orange Line NEMC Station was proposed, in addition to the Silver Line Boylston and Chinatown Stations proposed along the 1993 FEIS/FEIR alignment. (See Figure 2.3-2)

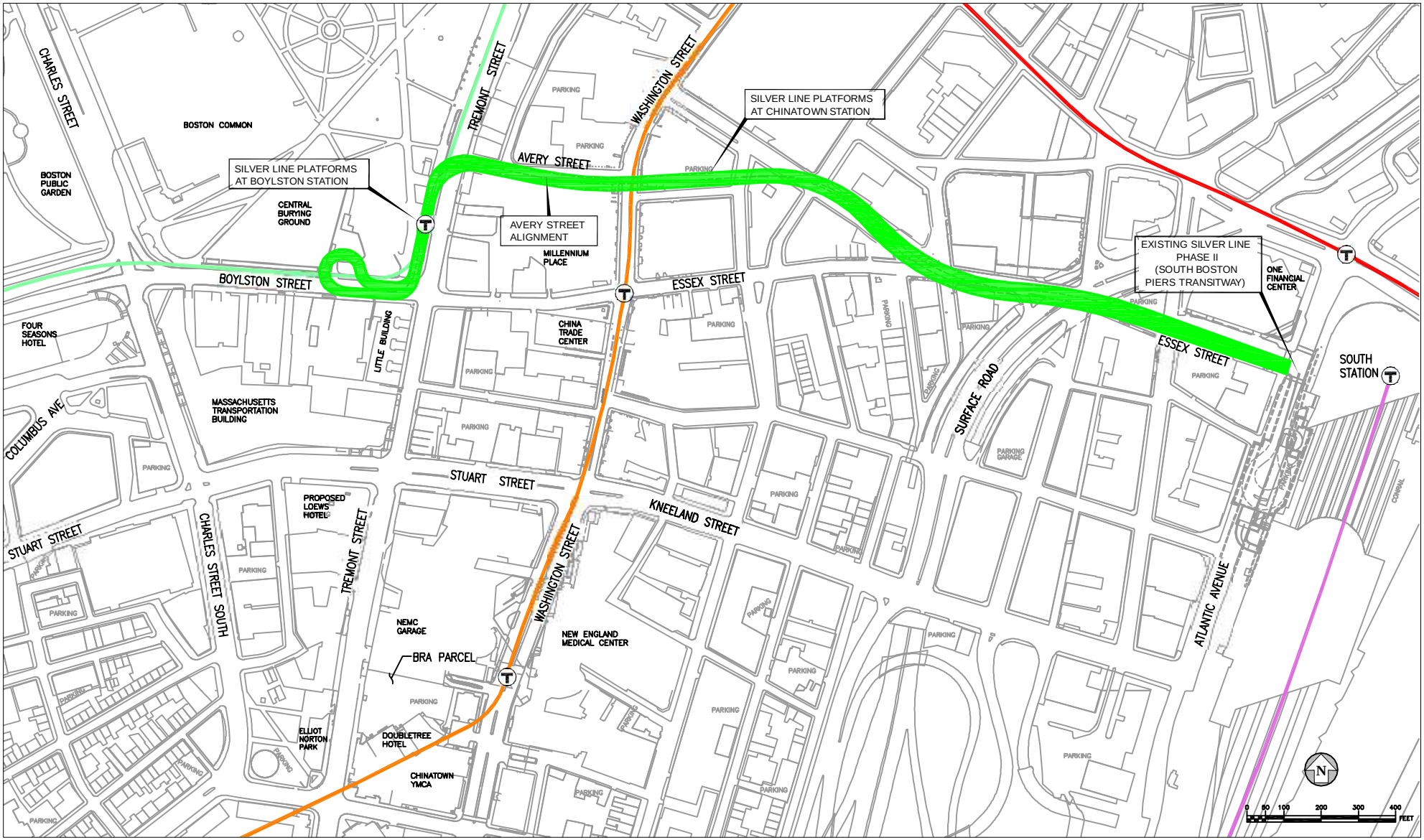


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Figure 2.3-1
1993 FEIS/FEIR Alignment

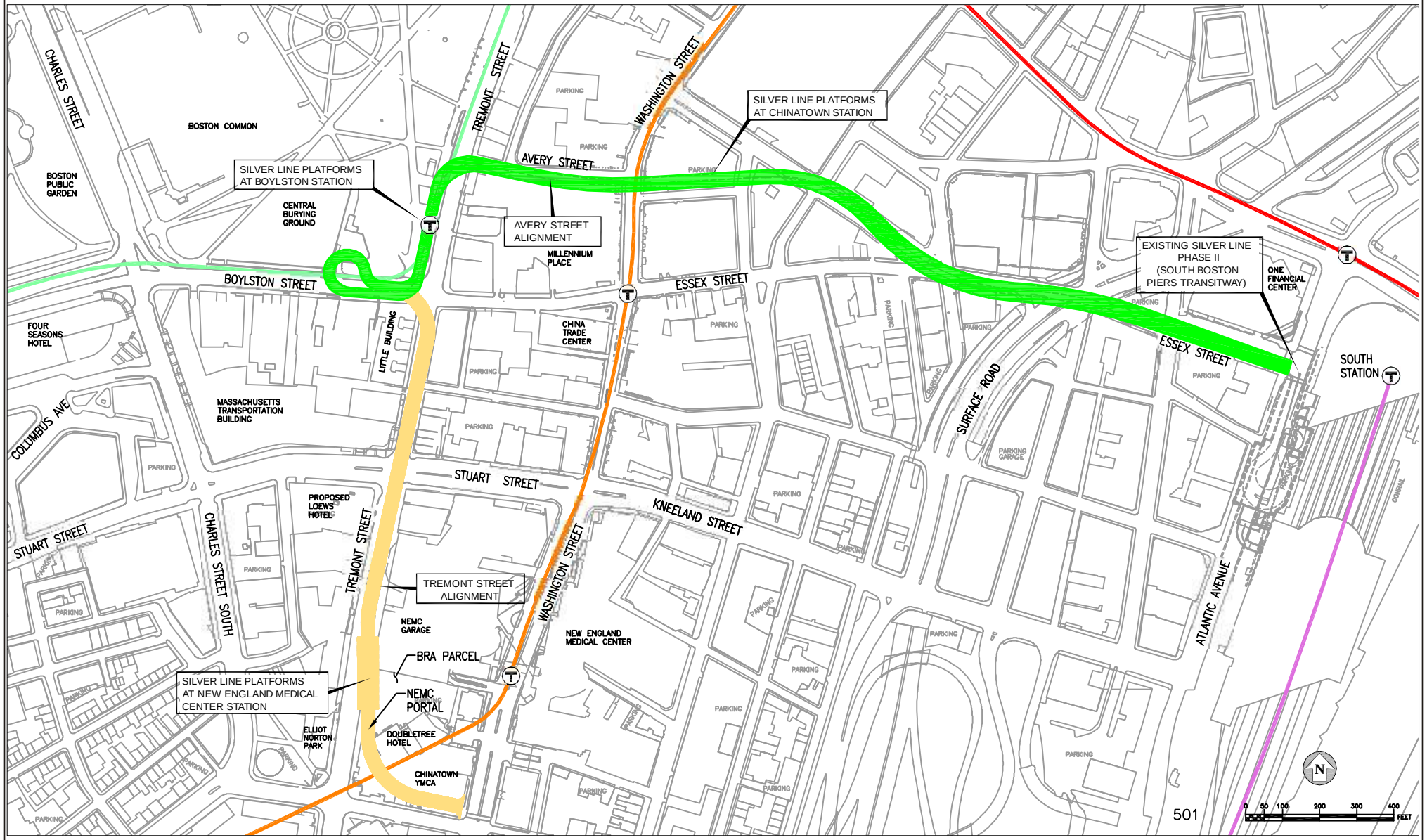

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Figure 2.3-2
1999 Notice of Project Change Alignment

2.3.3 Preliminary Engineering (PE) Request/2nd Annual Update Alignment

In April 2000, the alignment for a portion of the core tunnel segment was modified and relocated one block south, from Avenue de Lafayette and Avery Street to an Essex/Boylston Street alignment, as initially presented in the Essex/Boylston Street Alignment Conceptual Design Report. (See Figure 2.3-3.) The Essex/Boylston Street alignment has formed the basis for all subsequent alignments of the Core Tunnel Segment described in this document. This modified alignment was found preferable to the previous Avery Street alignment because of subsequent changes that had occurred in actual and planned development along the Avery Street corridor following completion of the 1993 FEIS/FEIR, along with the modified alignment's reduced impacts on historic resources and parklands.

The MBTA presented the modified Silver Line Phase III conceptual design in its request to the FTA to initiate preliminary engineering (January 2002), and in the *2nd Annual Update Pursuant to M.G.L. Section 61* submitted to EOEA (October 2002). The Silver Line Phase III alignment as presented in the 2002 documents was comprised of a tunnel following alignments along Essex, Boylston, and Tremont Streets, with a turnaround loop tunnel under the southeastern corner of the Boston Common. The Essex/Boylston Street alignment followed Essex and Boylston Streets between South Station and Boylston Station, with Silver Line Stations provided in the core tunnel segment at the existing Chinatown (Orange Line) and Boylston (Green Line) Stations. FTA approved initiation of preliminary engineering in July 2002.

The Essex/Boylston Street alignment reduced impacts on private property. (By contrast, the 1993 FEIS/FEIR Avery Street alignment would have passed completely beneath both the Millennium Place Development and the Textile Building, and through the future development parcel at Hayward Place.) At the time of the 1993 FEIS/FEIR, the Hayward Place/Avery Street Station location had been considered a preferred direct connection to the existing Orange Line Station. Due to the proposed large-scale mixed-use development then planned for the Hayward Place parcel, the MBTA and the Boston Redevelopment Authority (BRA) considered that location as a better opportunity to encourage transit oriented development. That development project, however, has not progressed; in the meantime, the large Millennium Place project has been completed one block south, obstructing the original Avery Street alignment. Therefore, the currently proposed Essex/Boylston Street alignment and Chinatown Station location presents a better design in terms of relative impacts and coordination of transit investments with development patterns.

The Essex/Boylston Street alignment provides a straighter alignment better suited to transit operations. This is a safer and more operationally efficient tunnel configuration than the Avery Street alignment, which used an at-grade tunnel crossing entering and exiting the station. The new alignment also eliminated the need for a 290-foot long pedestrian tunnel connecting the proposed Silver Line Chinatown Station with the existing Orange Line Chinatown Station, by locating the new Silver Line Station beneath the Orange Line Station, which provides for more convenient passenger transfers. Finally, the Essex/Boylston alignment reduced the impact to historic and culturally sensitive areas of the Boston Common, by relocating the Boylston Station turnaround loop from the vicinity of the Central Burying Ground (as had been proposed by the Avery Street alignment) to a location under the Boston Common north of the proposed station.

As in the 1999 NPC alignment, the Tremont Street portal route alignment provided an extension of the Silver Line tunnel from Boylston Station to a new Silver Line NEMC Station, providing an operational connection to the Silver Line Phase I service via a tunnel portal and ramp to the surface at Washington Street. The Chinatown YMCA occupies the location of the Silver Line portal to Washington Street that was proposed in the 2002 alignments. The Chinatown YMCA would have needed to be demolished and relocated to a new off-site location under this portal route alignment.

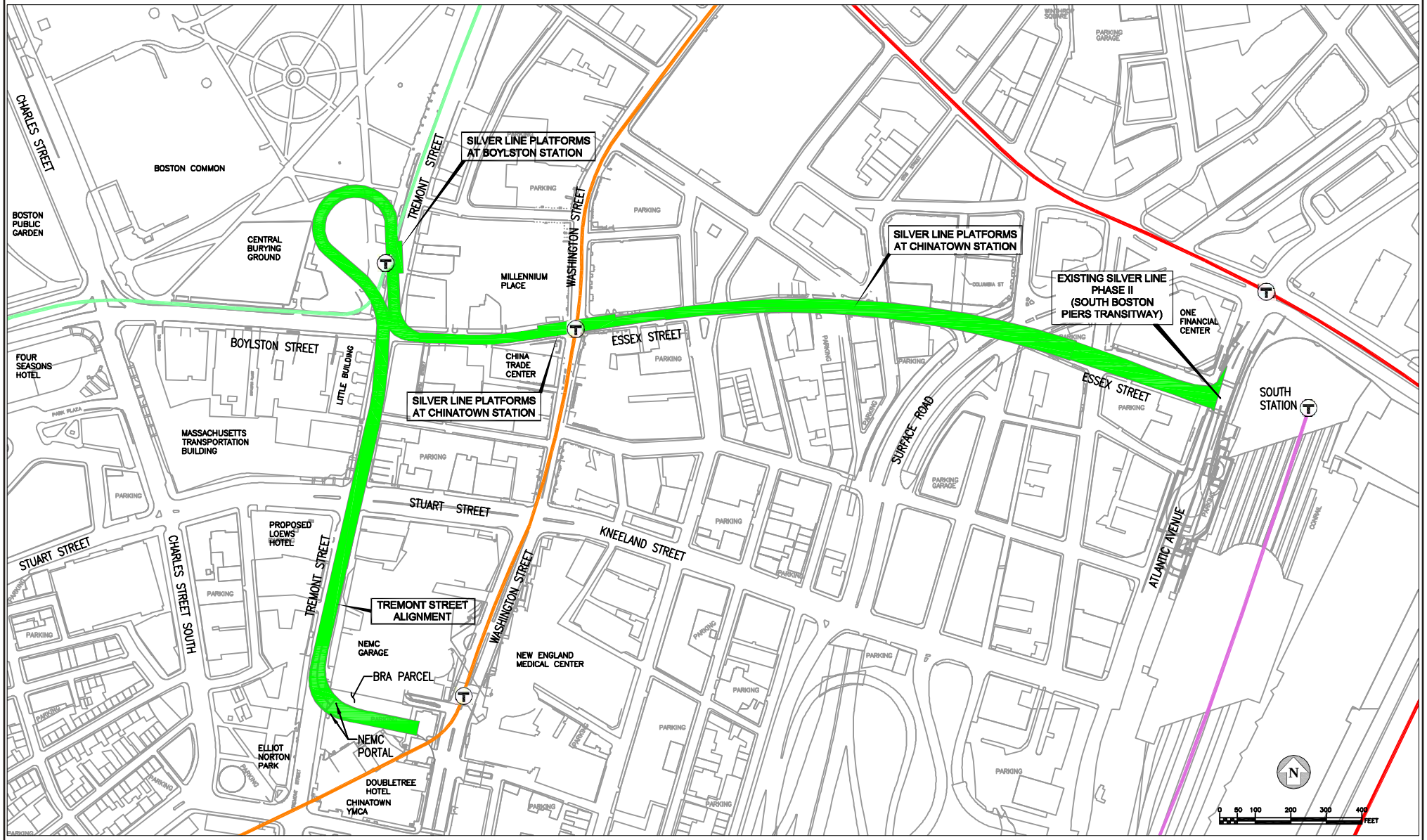

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Figure 2.3-3
2002 PE Request/
2nd Annual Update Alignment

2.3.4 Alignment Alternatives Presented in the 3rd Annual Update

Approval to initiate preliminary engineering was received from FTA in July 2002. Following selection of the consulting team, the MBTA then initiated Preliminary Engineering in 2003. As part of that engineering process, the MBTA undertook a further analysis and screening of portal route alternatives. These alternatives, which were discussed in detail in the 2003 *3rd Annual Update Pursuant to M.G. L. Section 61*, and are summarized below, were developed in response to comments from the FTA encouraging the MBTA to improve the cost effectiveness of the project, as well as in response to comments from the community regarding the proposed taking and relocation of the Chinatown YMCA. Out of this process emerged the basis for the Tremont Street/NEMC Portal alternative and the Charles Street/NEMC Portal alternative that are analyzed in this SDEIS/EIR. In addition, a wide range of other portal route alignments were screened and eliminated as infeasible or imprudent.

2.3.4.1 Screening of Initial Portal Options

As discussed in the *3rd Annual Update*, a series of alternatives to the original portal location were initially developed (part of the 2003 Group 1 Alternatives) that responded to community concerns regarding the taking of the Chinatown YMCA. A total of nine alternative inbound and outbound portal location options that avoided the Chinatown YMCA were evaluated through a screening process, with particular attention on technical feasibility and impacts on the local environment, including vehicular and pedestrian traffic and parking.

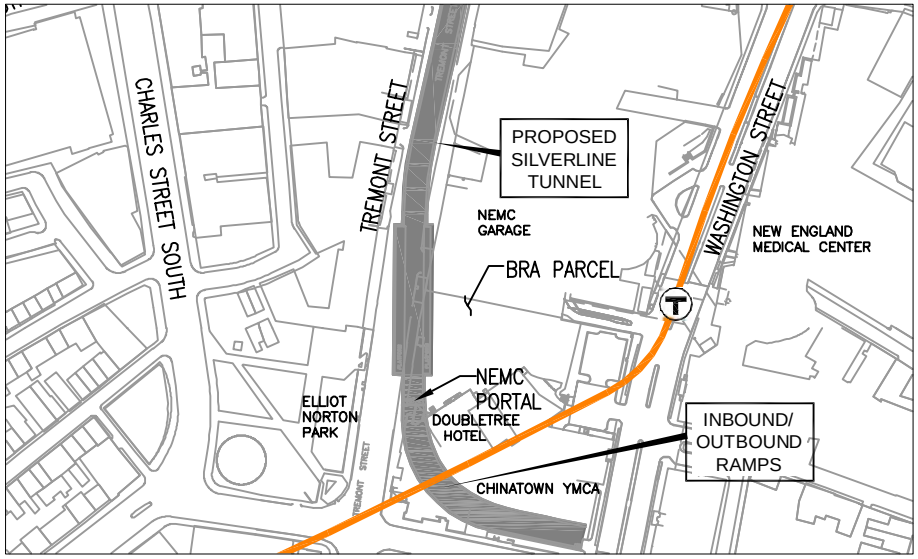
All of the portal location options avoided impacts to the Chinatown YMCA. These preliminary portal locations are indicated on Figures 2.3-4 through 2.3-6 and are described below. Each figure indicates the portal location options relative to the Chinatown YMCA portal, which has been eliminated. In addition, each option eliminated the underground NEMC Silver Line Station in favor of an at-grade station. Based on the preliminary portal location screening study, Portal Location Option 3, which calls for a dual inbound and outbound portal located between the Doubletree Hotel and the NEMC parking garage, was selected as the portal location for each of the subsequently developed Group 1 alignment alternatives. All other portal locations were eliminated from further consideration based on flaws identified in the portal location study and summarized for each location below.

Tremont Street – Portal Location Option 1

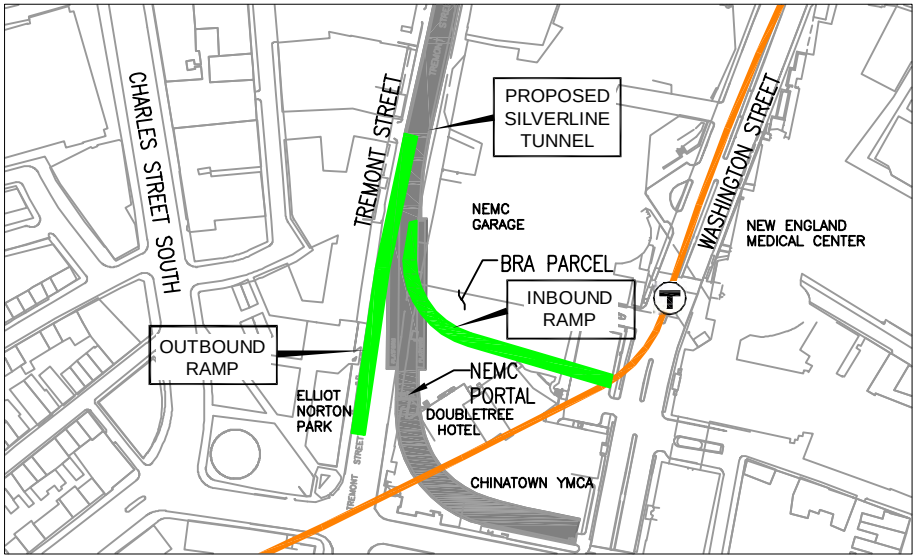
This option calls for the inbound portal to be located between the Doubletree Hotel and the NEMC parking garage and the outbound Portal to be located on the far (west) side of Tremont Street just north of the intersection with Oak Street to provide room for a bus stop location. Three one-way travel lanes would be retained on Tremont Street, but 25 parking spaces along Tremont Street would be lost for the length of the portal ramp. This option was eliminated because of excessive impacts.

Tremont Street – Portal Location Option 2

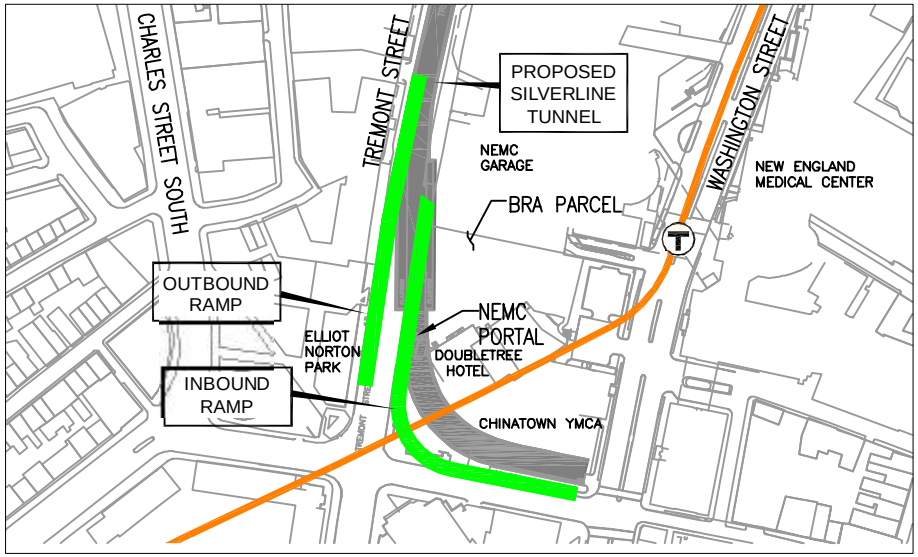
This option calls for the inbound portal to be located on Oak Street and the outbound portal to be located on the far (west) side of Tremont. Ramping down to the portal on Oak Street would reduce Oak Street to a one-way street. As a result, 25 parking spaces would be lost on Tremont Street, and sidewalk and pedestrian routing conflicts would be created at the northwest corner of the Oak and Tremont Street intersection. This option was eliminated because of excessive impacts.



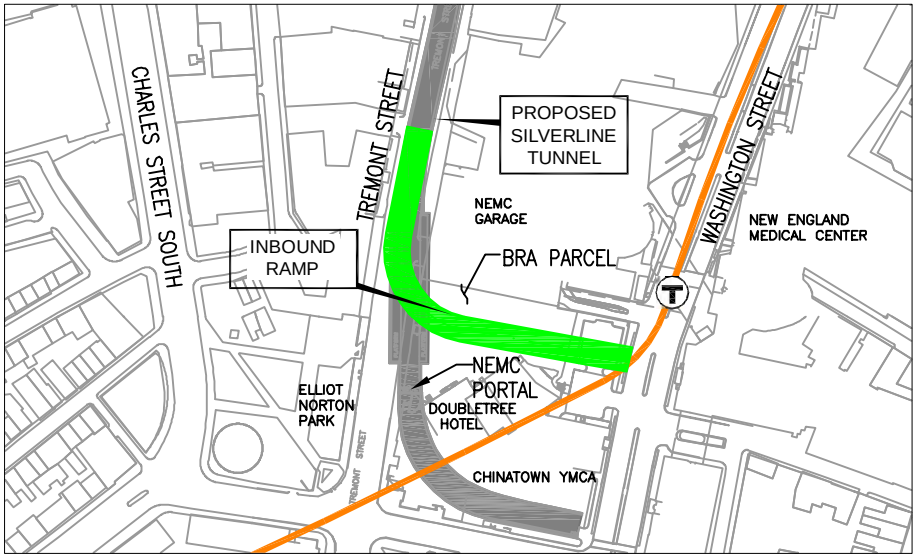
ORIGINAL BASE PLAN



TREMONT STREET - PORTAL LOCATION OPTION 1



TREMONT STREET - PORTAL LOCATION OPTION 2



TREMONT STREET - PORTAL LOCATION OPTION 3

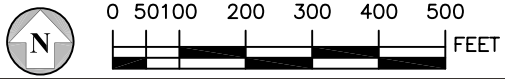


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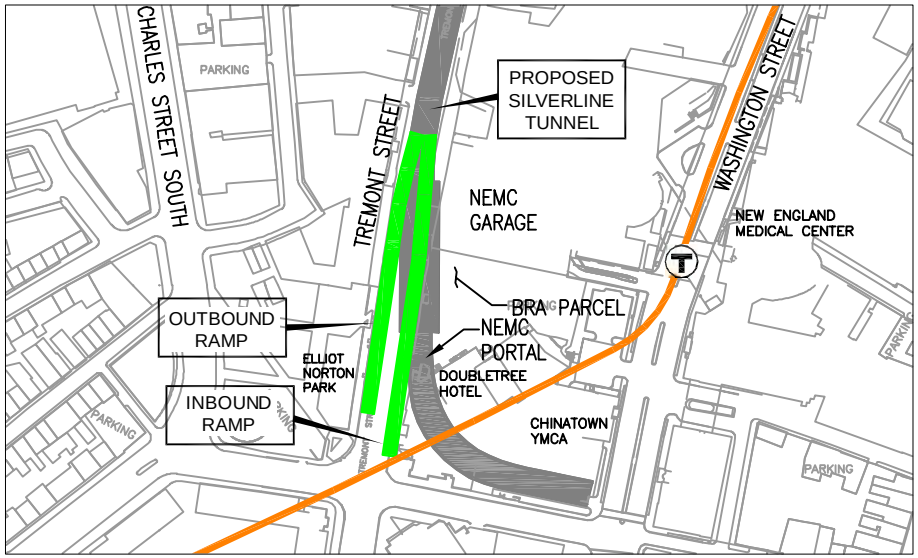
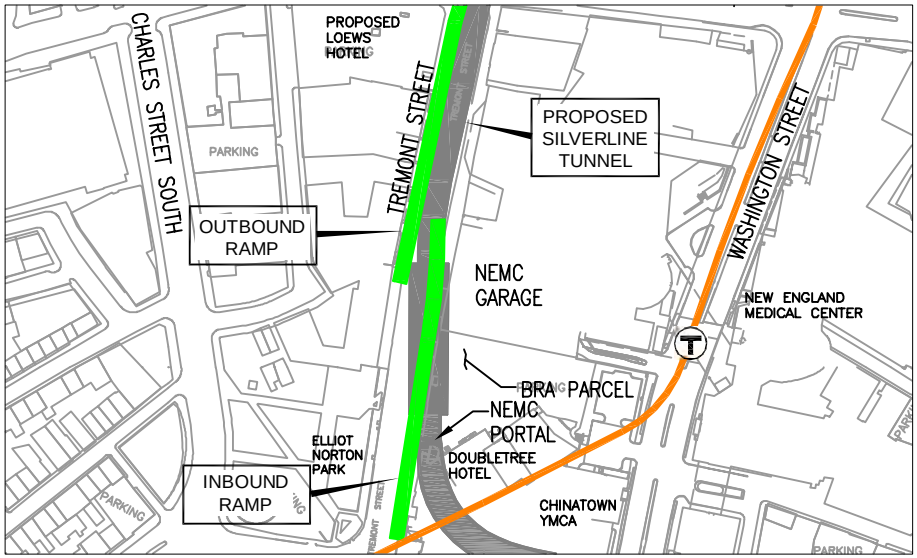
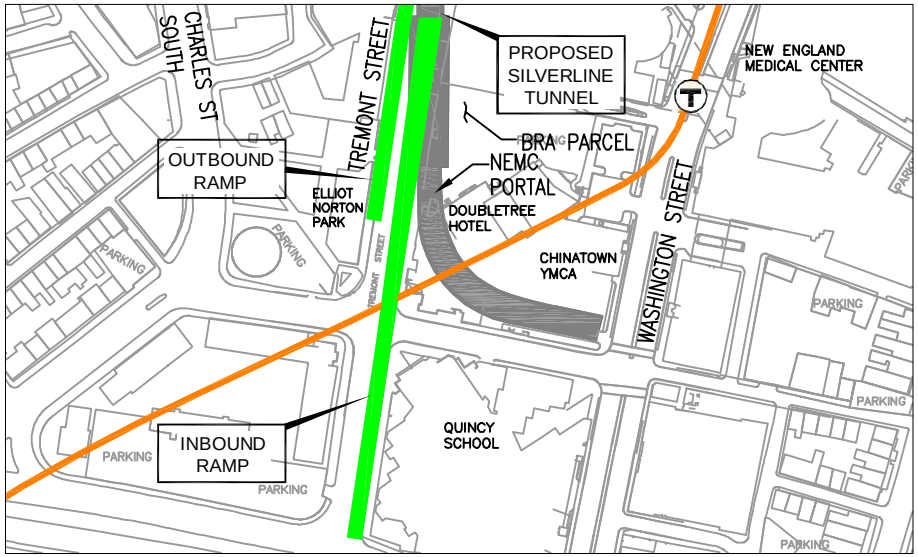
Figure 2.3-4
Preliminary Portal Options



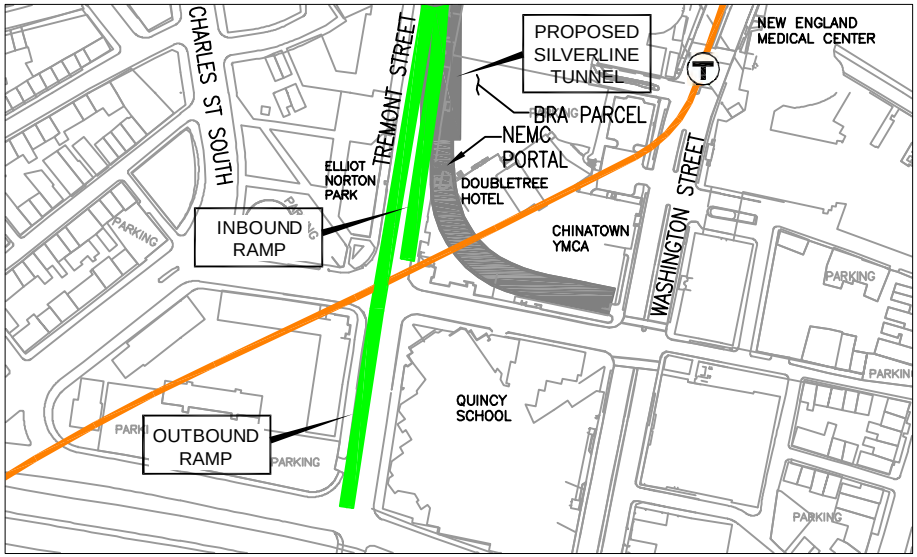
TREMONT STREET - PORTAL LOCATION OPTION 4



TREMONT STREET - PORTAL LOCATION OPTION 5



TREMONT STREET - PORTAL LOCATION OPTION 6



TREMONT STREET - PORTAL LOCATION OPTION 7

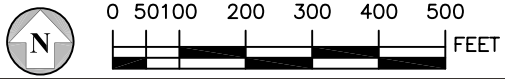


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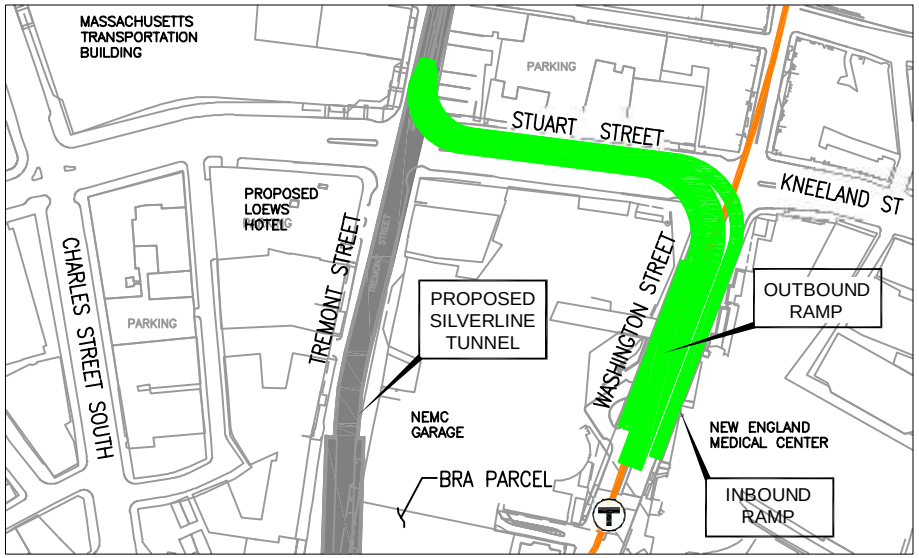
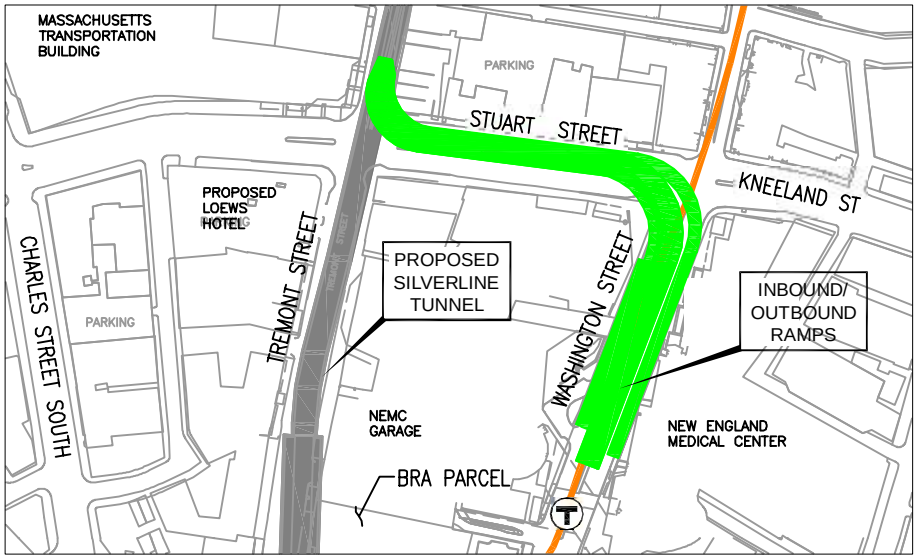
Figure 2.3-5
Preliminary Portal Options



WASHINGTON STREET - PORTAL LOCATION OPTION 8



WASHINGTON STREET - PORTAL LOCATION OPTION 9

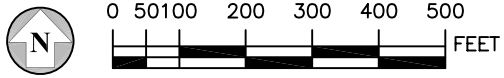


Figure 2.3-6
Preliminary Portal Options

Tremont Street – Portal Location Option 3

This option calls for a dual inbound – outbound Portal located between the Doubletree Hotel and the NEMC parking garage. Off-street parking at the Auto Parks lot and Doubletree Hotel would be affected, but there would be no loss of parking on Tremont Street. However, some on-street parking spaces would be lost on Washington Street to accommodate the portal ramp to grade. Development rights over the portal ramp (boat section) would be retained.

Tremont Street – Portal Location Option 4

This option calls for two portals, inbound and outbound, both located on Tremont Street. The Inbound portal would be located on the east side of Tremont and buses would enter from Oak Street. This parallel dual alignment of portals along Tremont Street would significantly restrict traffic operations by reducing the number of travel lanes to two lanes and sidewalk widths to a maximum of eight feet. In addition, 25 on-street parking spaces would be lost. Excavation of both portal ramps would require an extended construction schedule, thus extending the period of construction impacts on Tremont Street. This option was eliminated because of excessive impacts.

Tremont Street – Portal Location Option 5

This is a variation of Option 4. The outbound portal on Tremont Street would be pushed back to the north, offsetting it from the inbound portal and thereby avoiding the restriction of traffic lanes associated with Option 4. However, pushing the portal further north moves the ramp section to an area of unfavorable surface road profile; it would require a significantly longer open ramp (boat section) to the portal along Tremont Street, which would extend back to Stuart Street through the area of the Wang and Shubert Theatres. Operationally, three travel lanes would be retained, but all on-street parking along Tremont Street from Oak Street to Stuart Street would be lost. In addition, all mid-block street pedestrian access and crossing would be blocked. This option was eliminated because of excessive impacts.

Shawmut Avenue – Portal Locations Option 6 and Option 7

These two options are variants of one another; they would locate one portal in the Shawmut Avenue block between Oak Street and Marginal Road, and the other portal on Tremont Street north of Oak Street. The options only vary as to the placement of the inbound or outbound portal on Shawmut Avenue. The problem with these two options is the limited length of Shawmut Avenue and its unfavorable grading. The boat section ramping up or down on Shawmut Avenue would have to be completed with the face of portal or tunnel entrance set just before the Oak Street intersection. This could only be accomplished by raising the intersection elevation approximately seven feet which is clearly problematic given the abutting properties and proximity of other roadway intersections. These options were eliminated because of excessive impacts and technical infeasibility.

Washington Street – Portal Location Option 8 and Option 9

These two options are variants of one another; they would locate the portal on Washington Street beyond the MBTA Orange Line Station entrance and prior to Stuart Street, either as two portals (inbound and outbound) located to the outsides of the travelway, or as a common dual portal down the middle of the street. Parking on both sides of Washington Street would be lost, and pedestrian street-crossing movements would be blocked under either of these options. In addition, the shallow cover depth over

the existing Orange Line Tunnel makes Options 8 and 9 infeasible to construct. These options were eliminated because of excessive impacts and technical infeasibility.

2.3.4.2 2003 New Starts Alternative

The alignment identified as the 2003 New Starts Alternative, which was presented to FTA in the annual New Starts submittal on August 29, 2003, was similar to the *2nd Annual Update Pursuant to M.G. L. Section 61* alignment described in Section 2.3.3 above, with the following changes. The 2003 New Starts Alternative eliminated the underground Silver Line NEMC Station, and it relocated the Washington Street tunnel portal to a parcel located between the Doubletree Hotel and the NEMC Garage (portal location Option 3 above). Under this alternative, the Silver Line Station at the NEMC would be on the surface. The NEMC portal was selected since, in addition to eliminating the need to take and relocate the Chinatown YMCA, it did not require the taking of existing travel lanes, and it resulted in the least impact to vehicular and pedestrian traffic and parking of the nine alternatives evaluated. (See Section 2 of the *3rd Annual Update* for additional discussion of this screening process. The 2003 New Starts Alternative is one of the Group 1 Alternatives discussed in the *3rd Annual Update.*)

In addition to the NEMC portal relocation, this stage of the alternatives analysis also examined ways in which the capital costs of Silver Line Phase III could be reduced, while maintaining ridership and other project benefits. Eliminating the cost of taking and relocating the Chinatown YMCA supported this objective, as did elimination of the underground NEMC Station. Additionally, three additional Group 1 alternatives (all of which incorporated the NEMC portal location as proposed in the 2003 New Starts Alternative) looked at the cost savings and ridership impacts of replacing the separate Silver Line Stations at Boylston and Chinatown Stations with a single mid-block station on Essex Street. These alternatives were examined to determine the cost savings that would be afforded by one combined station and, in two cases, elimination of the Boylston Loop as well.

All four of the 2003 Group 1 Alternatives (2003 New Starts, plus three mid-block alternatives; Mid-Block/No Loop; Mid-Block/Bidirectional South Station Loop, and Mid-Block/Non-revenue Loop) utilized a Tremont Street alignment and avoided taking and relocating the Chinatown YMCA. (See Figures 2.3-7, 2.3-8, 2.3-9, and 2.3-10.) However, as discussed previously and in Section 2.3.4.3 following, the Mid-block and No-loop alternatives presented operational deficiencies and reduced ridership, when compared to the 2003 New Starts Alternative, which provides Silver Line platforms at both the existing Green and Orange Line Stations at Boylston Station and Chinatown. The 2003 New Starts Alternative was the only one of the Group 1 alternatives found to be feasible, because it alone could meet the critical cost effectiveness threshold according to FTA requirements. In addition, each of the Mid-block alternatives failed to satisfy design and/or operational criteria established for Silver Line Phase III. Thus, the three mid-block station alternatives were eliminated from further consideration.

2.3.4.3 Screening of Mid-block and No-loop Alternatives

Three of the Group 1 alternatives presented in the *3rd Annual Update* and then eliminated from further consideration proposed a mid-block station concept (instead of a separate Chinatown and Boylston Silver Line stations) and/or eliminated a Boylston turnaround loop. This section discusses why the mid-block and no loop alternatives were eliminated because of failure to satisfy the design, operational, and/or cost-effectiveness criteria for Silver Line Phase III.

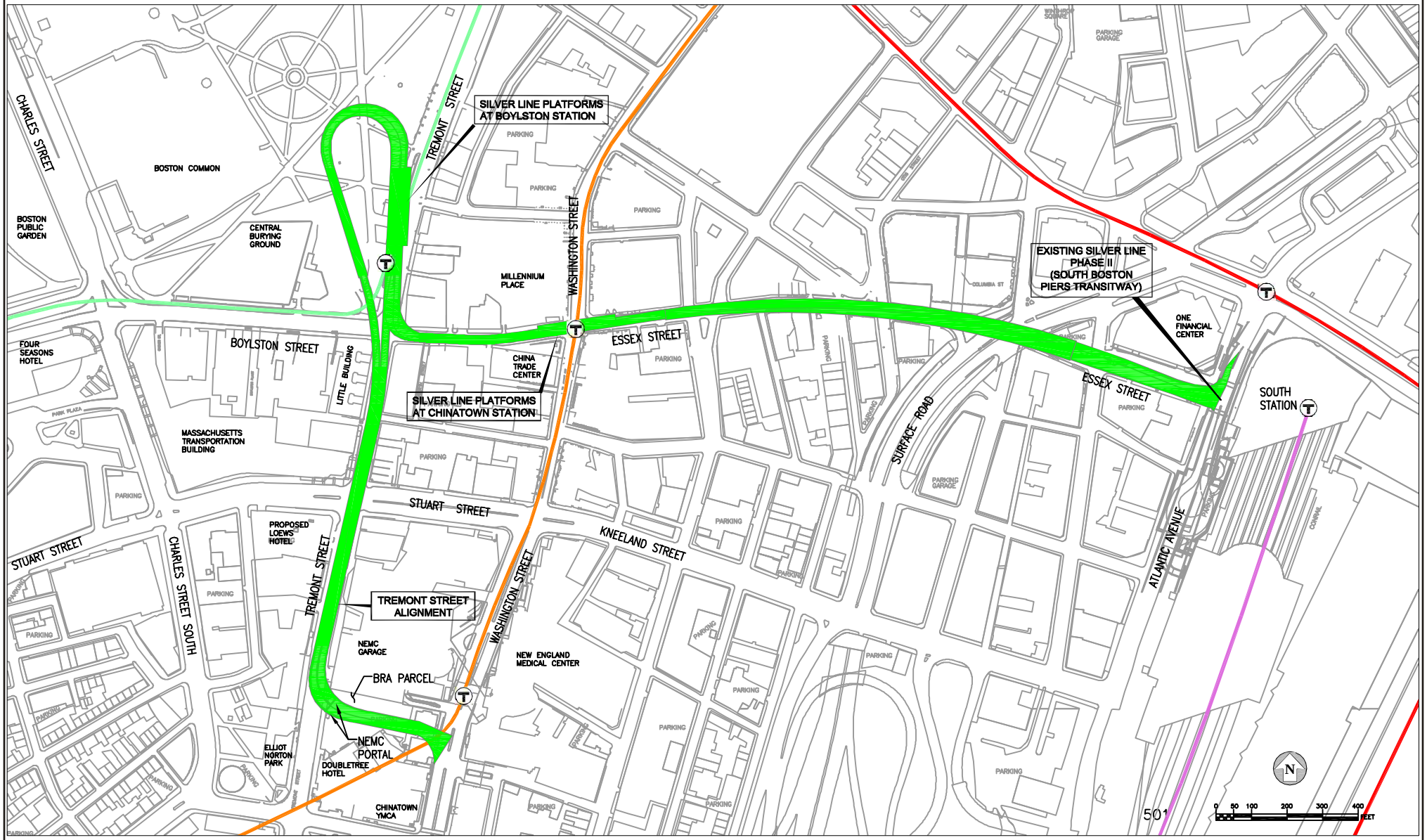


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Figure 2.3-7
2003 Annual Update
Alternative

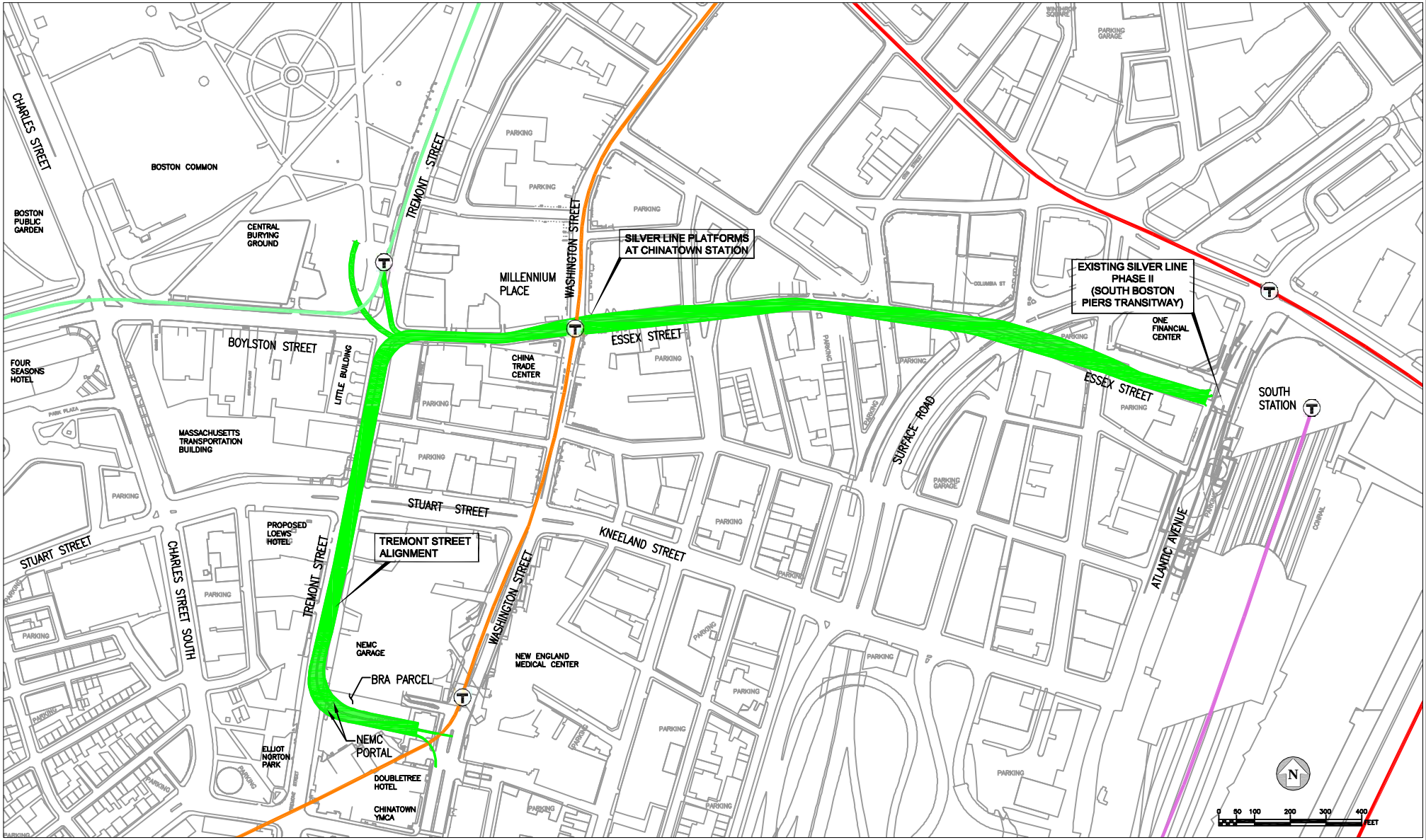

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Figure 2.3-8
Midblock No Loop Alternative

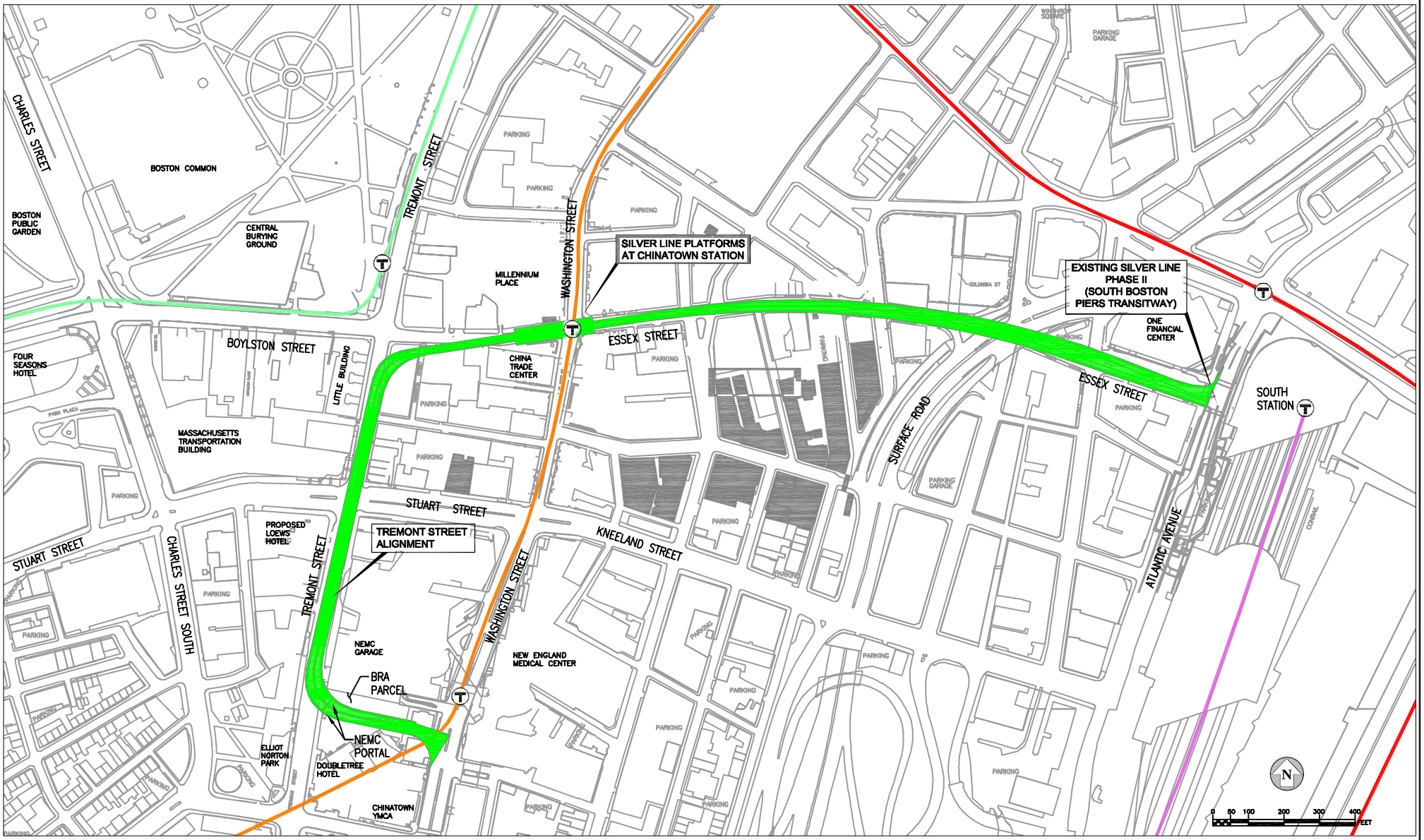

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Figure 2.3-9
Midblock Bi-directional
South Station Loop Alternative

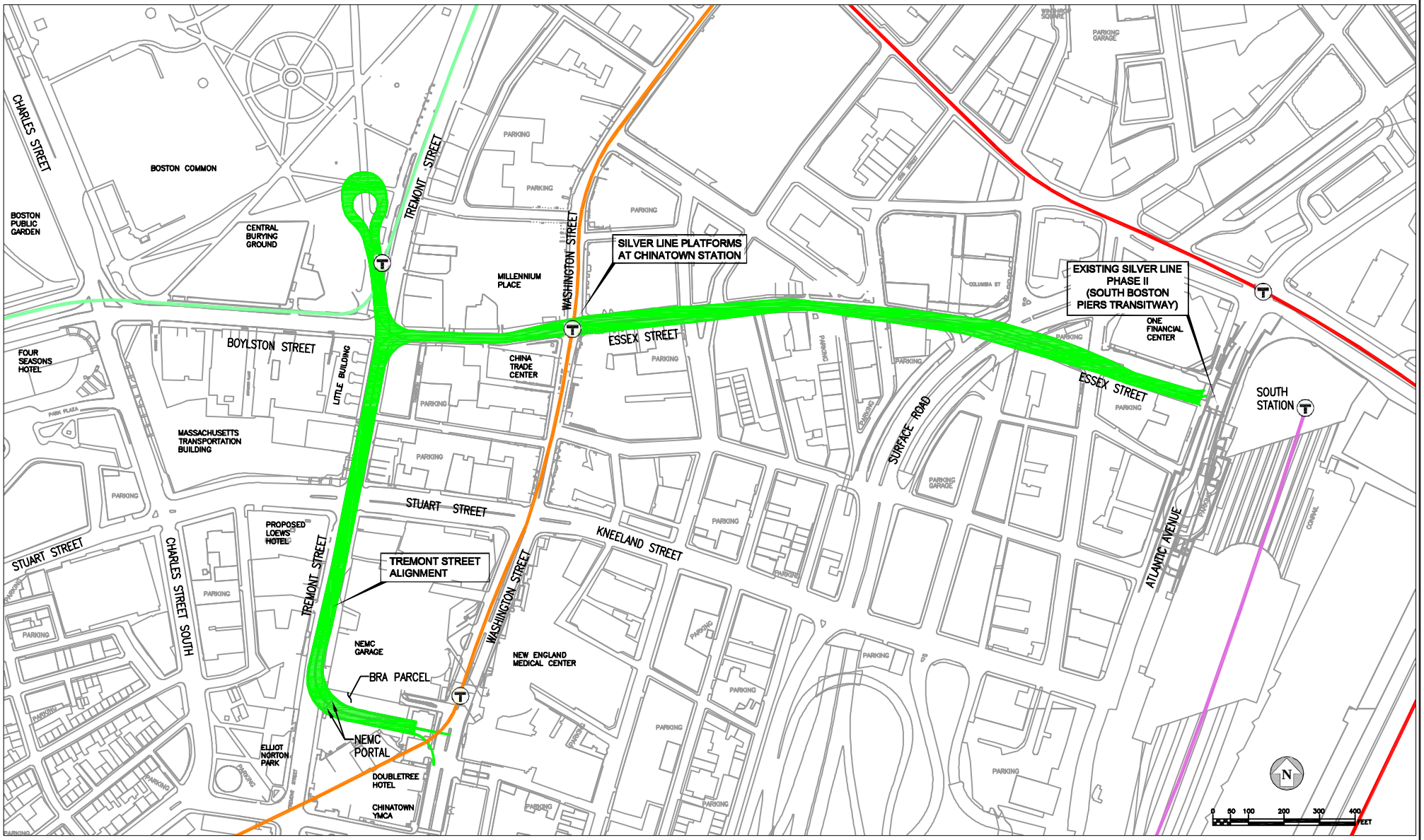

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Figure 2.3-10
Midblock Non-revenue
Boylston Loop Alternative

Boylston Loop

As described in Section 2.2.3, the Silver Line service plan provides a high service frequency and person-capacity within the "Core" Tunnel Segment to serve the high passenger demand between the downtown core and the South Boston Waterfront. To adequately meet this demand, approximately three out of four vehicles are "short-turned" after the Boylston Station for a return inbound trip towards the waterfront. The Boylston Loop allows short-turning vehicles to complete this movement in the quickest possible fashion, so that vehicles may be re-entered into revenue service in the opposite direction of travel, thereby minimizing operating costs and vehicle requirements.

An existing unidirectional turnaround loop, located just beyond South Station at the terminus of the Phase II alignment is currently used to reverse Phase II vehicles at the end of their inbound trips. Under Phase III operations, this turnaround loop would be located in the midsection of the high passenger demand segment between Boylston Station and the South Boston Waterfront, rather than at the end. Due to its physical location in the "center" of the Phase III high demand segment, a turnaround loop at South Station would be of no operational use in meeting this goal.

In the full build scenario with the Boylston Loop, approximately 18 vehicles/hour in each direction would pass through the NEMC or Columbus portals. If the Boylston Loop were removed from the Phase III alignment, the "short-turning" movement would have to be completed outside of the Silver Line portal on surface streets and all 74 vehicles/hour would pass through the portal in each direction, taxing the capacity of the portal and surrounding streets. This situation would result in increased travel time and operating costs, unpredictable service delays due to traffic congestion, and added vehicle delays related to inbound and outbound mode changes. (See Technical Appendix A for a more detailed discussion of the Boylston Loop.)

The Boylston Loop ensures that the physical infrastructure of the Phase III tunnel meets the operational requirements of the full build service plan and the forecasted ridership patterns. Therefore, those alternatives that did not include an underground turnaround loop, or provided for a loop at South Station, were eliminated from further consideration because of failure to satisfy these criteria.

Mid-Block Station

Instead of individual Chinatown and Boylston Stations as part of the Core Tunnel Segment, the "mid-block" station concept would provide only one station located along Boylston Street between Washington and Tremont Streets, with pedestrian connections to both the Orange Line (at Chinatown Station) and the Green Line (at Boylston Station). One presumed benefit of this concept was that by building one station instead of two, the MBTA could reduce the capital cost of the project, thereby making it more competitive from a financial point of view. The Mid-Block concept was initially studied in 2003, and presented in the *3rd Annual Update* among the Group 1 alternatives utilizing a Tremont Street alignment. It was then reevaluated in response to comments on the *3rd Annual Update*, assuming a Tremont Street alignment, with a portal at NEMC and a turnaround loop at Stuart Street. The following provides a summary of the reasons why this concept was eliminated from consideration. A more detailed discussion may be found in Technical Appendix A.

The MBTA evaluated the concept of a mid-block station with regard to three Silver Line Phase III criteria:

1. Technical Feasibility: Conformance to MBTA Design, Engineering and Construction Standards;

2. Station Functionality and Transit Operations; and,

3. Financial Feasibility: Capital and Operating Costs, and Cost-Effectiveness as defined by the FTA.

MBTA Design, Engineering and Construction Standards

As described in Section 2.2.2, the MBTA established a maximum preferred grade of 5 percent for the Silver Line in 1993, with an absolute maximum of 6 percent under specific circumstances. The Silver Line Phase Bus Rapid Transit (BRT) dual mode vehicle is constrained to operate at a maximum grade of 6 percent. The Mid-Block alignment utilizing Tremont Street would require a grade of 6.4 percent along Tremont Street between the NEMC portal and Boylston Street. This grade exceeds both the 5 percent maximum preferred grade and the 6 percent absolute maximum grade criteria.

Station Functionality and Transit Operations

As described in Section 2.2.4, one of the major determinants for a successful transit station or system is its ability to function under the proposed service plan. Access time, passenger travel time and vehicle headways are significant factors affecting travel demand for the service. A single mid-block station would on average, be further away from a group of trip origins and destinations than two stations. The longer access time to a mid-block station would increase the overall passenger travel time, which in turn would make the trip less attractive to potential users, thereby reducing ridership. Transfer time is another important factor. The longer it takes to transfer (for example between the Orange Line and the Silver Line), or the more cumbersome that transfer is, the less likely a person is to make the trip and therefore, ridership would be reduced.

A mid-block station would serve the same passenger catchment area as the two individual Boylston and Chinatown Stations, and therefore the passenger demand at the mid-block station would be higher than at either of the two individual stations. However, there is less platform capacity at the mid-block station to meet this demand. The two stations provide a total of two platforms with six vehicle berths per direction. The mid-block station on the other hand provides a single three-berth platform per direction to service essentially the same demand, in spite of the longer vehicle dwell times at the mid-block station[2]. The longer dwell times are needed to accommodate the higher levels of passenger boarding and alighting which then translate into vehicle delays, reduced system capacity, longer passenger travel times, and reduced ridership.

More importantly, during peak periods the dwell time at a mid-block station could quite often exceed the vehicle arrival headways (approximately 49 seconds), resulting in unacceptable service delays throughout the system. With only three berths per direction at the mid-block station as opposed to a combined six berths at Boylston Station and Chinatown, the system will be less adept at absorbing these operational "shocks" without impacting service elsewhere in the system.

Lengthening of the mid-block platform to include four or more vehicle berths would have little, if any, operational benefit. In the absence of a passing lane, which is infeasible due to right-

[2] A number of phenomena contribute to the longer vehicle dwell times at the mid-block station. The sheer number of passengers boarding and alighting at this key transfer station results in longer dwell times than at either Boylston or Chinatown Stations alone. Second, the large volume of passenger boarding activity and platform/vehicle congestion ("passenger turbulence") increases the average boarding/alighting time per passenger. Third, 3 out of 4 vehicles must be completely de-boarded at the westbound platform because of vehicles being short-turned in the Boylston loop for a return eastbound trip, which extends the dwell time. Other boarding events (e.g., wheelchair ramp deployment, stroller loading, etc.) also tend to take longer under these conditions and have amplified operational effects on the system as a whole in the mid-block scenario.

of-way and cost considerations (discussed below), having more than three "in line" berths in this station yields virtually no additional platform capacity—yet it would result in a significant capital cost increase.

Capital and Operating Cost and Cost Effectiveness

As described in Section 2.2.4, the financial feasibility criterion reflects upon eligibility for federal New Starts funding. Funding eligibility requires satisfying the FTA's cost effectiveness standards. The mid-block station alternative would have a capital cost similar to the two-station alternatives (Boylston and Chinatown), due to additional elements associated with the station design and the turn around loop. A mid-block station would need to be larger to accommodate a higher passenger volume and emergency egress at a single station, as compared to each of the two individual stations. Boylston Street at the proposed Mid-block station location has a narrow right-of-way, so a wider station would encroach on private property for most of its length. Abutting structures (many of which are historic) would need to be underpinned to accommodate the mid-block station, resulting in higher real estate acquisition and building mitigation costs than the two-station alternatives, which would be subject to greater risk of increase over time.

In addition, a turnaround loop at the Boylston and Charles Streets intersection would not be practical with a mid-block station, as a turnaround loop at this location would require longer non-revenue travel time. An alternate location for the loop was identified at the southwest corner of Tremont and Stuart Streets. The site, currently used as a parking lot, is proposed for the construction of a new, fully permitted, 25-story Loews Hotel. The turnaround loop would occupy parking and other service areas of the hotel that the MBTA would need to mitigate in their design and construction, resulting in significantly higher acquisition and building mitigation costs for this turnaround loop option.

In summary, while the capital cost of the mid-block alternative is similar to the other alternatives with two stations, it results in a drop in ridership and user benefits, thus giving the mid–block alternative a poor cost-effectiveness ratio when compared to the two-station alternatives. As a result, the MBTA determined that a mid-block alternative is neither prudent nor feasible, based on the Silver Line Phase III screening criteria, and it was eliminated from further consideration

As part of an on-going effort, the MBTA will continue too review design alternatives that reduce cost and minimize disruption to abutters without sacrificing adequate service to the ridership including a mid-block station alternative.

2.3.4.4 Revised Group 2 Alternatives

The Group 2 Alternatives, which were also described in the *3rd Annual Update*, evolved from the 2003 New Starts Alternative in response to two issues. First, the ridership forecasting conducted in support of the New Starts submittal to FTA indicated that the passenger demand for the Silver Line would exceed the vehicle berthing capacity of the single Silver Line platform proposed for Boylston Station under the 2003 New Starts Alternative. Second, the MBTA held meetings with representatives from the City of Boston Parks and Recreation Department, the Boston Landmarks Commission, and the Massachusetts Historical Commission at which concern was expressed regarding the impacts of constructing the Silver Line Boylston Station and turnaround loop alignment beneath the southeast corner of the Boston Common.

The MBTA undertook an additional alternatives analysis during the fall of 2003 to examine ways of addressing these two issues, while at the same time maintaining ridership levels and not exceeding the capital cost and user-benefits benchmark of the 2003 New Starts Alternative. All of the Revised Group 2 alternatives kept the same alignment along Essex and Boylston Streets as the 2003 New Starts Alternative.

One of the Revised Group 2 alternatives (Revised New Starts Alternative) proposed modifications to the Boylston Loop Silver Line Station platform to accommodate the projected ridership demand, thereby enlarging the size of the loop beneath the Boston Common. (See Figure 2.3-11.) The other three alternatives (Tremont Street (see Figure 2.3-12), Charles Street with NEMC Portal, and Charles Street with Elliot Norton Park Portal Alternatives) replaced the Boylston Loop with alternate Boylston Station and turn-around loop locations. This version of a Tremont Street alignment located Boylston Station within Tremont Street and the turnaround loop at Stuart Street. Both of the Charles Street alternatives located Boylston Station within Boylston Street and the turnaround loop entirely within the roadway intersection of Boylston and Charles Streets, thereby eliminating potential impacts of the turnaround loop to the Boston Common. (This turnaround loop location is now part of the Core Tunnel Segment.) In addition, an alternate to the NEMC portal location (Elliot Norton Park) was investigated for the Charles Street alignment alternatives.

As discussed in the *3rd Annual Update*, each of the Group 2 alternatives met the MBTA's cost effectiveness objective. Therefore, the key considerations for screening of the Group 2 alternatives were engineering design criteria relative to system operation and safety. While the Tremont Street/Stuart Street Loop Alternative had a slightly lower capital cost (primarily due to a shorter tunnel length), the grade constraints posed by the location of Boylston Station within the Tremont Street corridor and the geometry of the turn-around loop on Stuart Street resulted in a design that did not meet the MBTA's design standards from an operational and safety perspective. This alternative would require a grade of 8.5% along Tremont Street between Boylston Station and the NEMC portal, which exceeds the maximum allowable grade of 6% as described in Section 2.2.2.

For these reasons, the design would not have been compatible with the design of the Silver Line Phase II portion of the tunnel, nor would the design have been compatible for future conversion to light rail, as described in Section 2.2.2. It also resulted in a shorter inbound platform at Boylston Station than the other alternatives. In addition, the Stuart Street loop would have required a permanent easement through the Loews Hotel development site, creating a significant impact to the hotel's subsurface parking and other hotel functional areas (laundry, kitchen etc.) which would need to be financially mitigated and accommodated by joint development. (See the previous discussion in Section 2.3.4.3.) Therefore, the 2003 Tremont Street Alignment Alternative was eliminated from further consideration. (A more detailed discussion of the evaluation and screening process is provided in the *3rd Annual Update*.)

The remaining three alternatives, the Revised New Starts Alternative, and the Charles Street alignment alternatives with a portal at either NEMC or Elliot Norton Park, were considered as viable candidates for Phase III of the Silver Line, and they were presented for public review and comment in the *3rd Annual Update*.

Public comment on the alternatives presented in the *3rd Annual Update* indicated that the new portal alignments defined by the Group 2 Alternatives extended the impacts of the project into areas and neighborhoods that had not previously been considered during the earlier MEPA and NEPA review procedures. As a result, several new issues arose from the communities that would now be affected by the project, among them:

- Concern over potential construction phase impacts to Elliot Norton Park associated with the Charles Street/NEMC Portal Alignment, and the potential for permanent impacts associated with the Charles Street/Elliot Norton Park Portal Alignment. The Bay Village neighborhood requested additional investigation of a Tremont Street alignment to avoid these park impacts. (See the Mid-block station discussion in Section 2.3.4.3.)

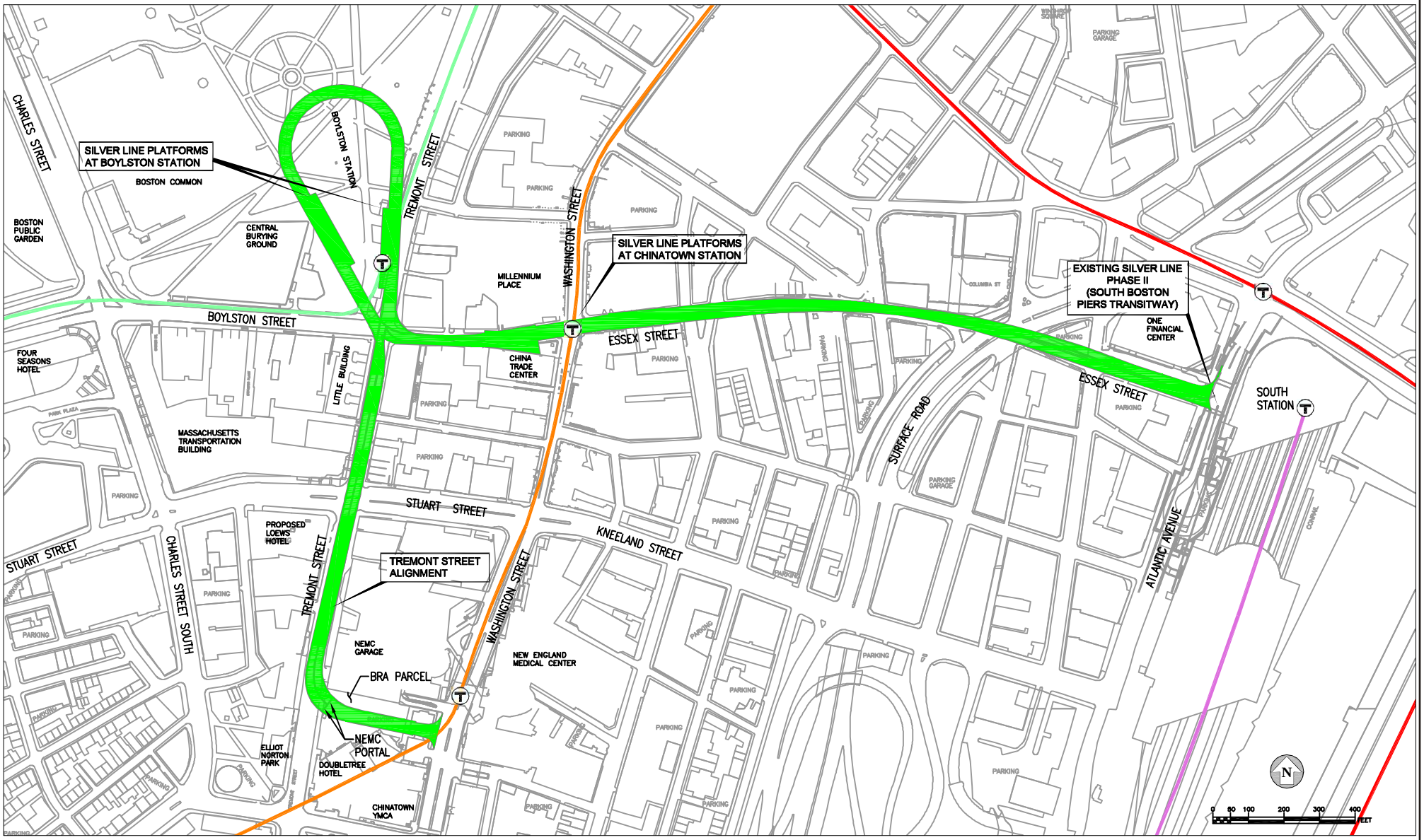

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Figure 2.3-11
Revised New Starts Alternative

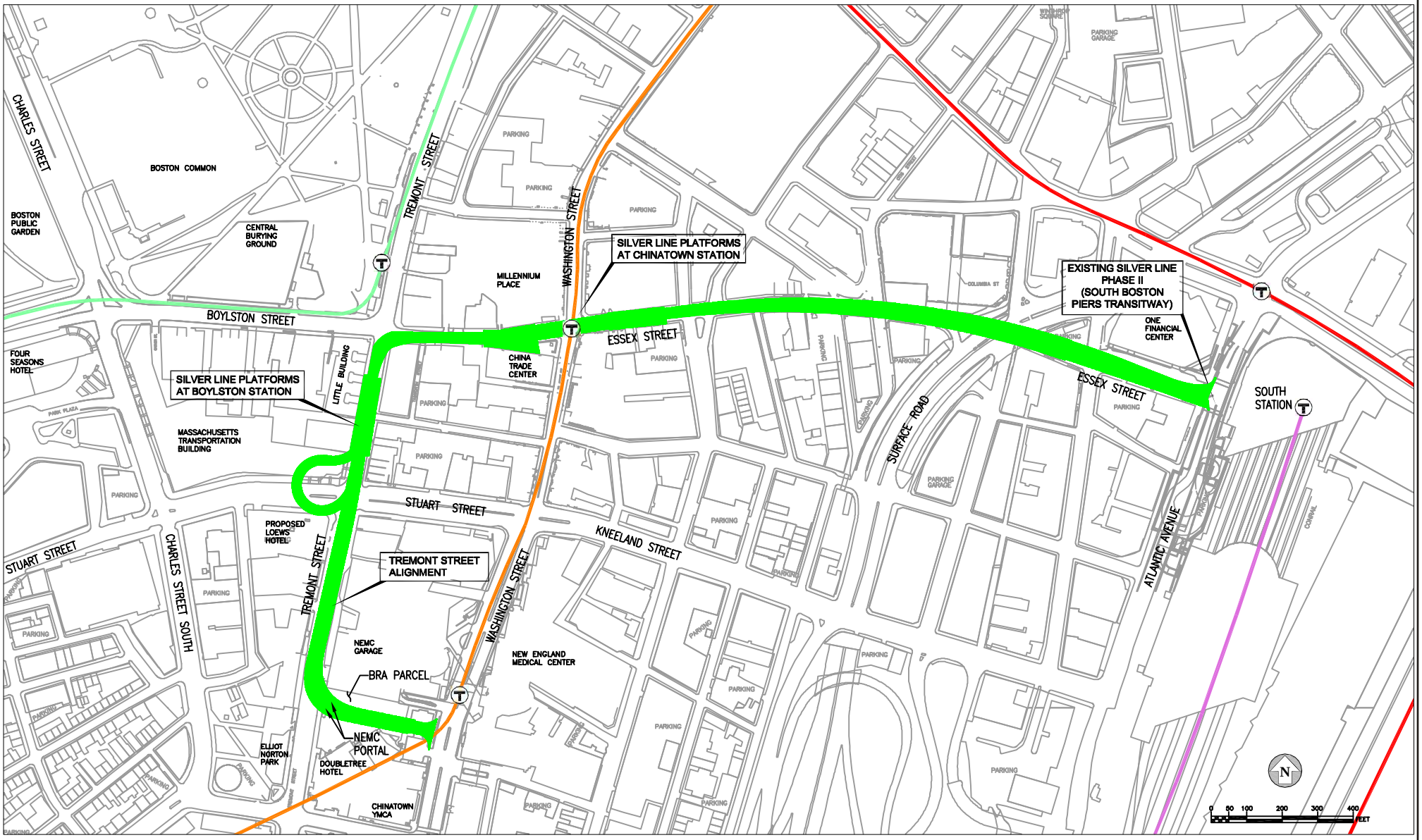

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Figure 2.3-12
Tremont Street Alternative with Stuart Street Loop

- Continued concern over the impacts of the Boylston turnaround loop associated with the Revised New Starts Alternative upon the Boston Common. The MBTA's response to this concern led to development of a new Tremont Street alignment with a turnaround loop at Boylston and Charles, presented in the 2004 NPC (see Section 2.3.5).

- A request to consider alternate portal locations that would more directly facilitate service to the Back Bay, as well as to the Washington Street corridor. The MBTA's response to this request led to development of the Columbus Avenue alignment alternative (see Section 2.3.5).

2.3.5 2004 Notice of Project Change Alignment Alternatives

Based on the comments received on the *3rd Annual Update*, the MBTA determined that a SDEIS/EIR would provide an opportunity for full public review and comment on the alternative alignments under consideration for Silver Line Phase III. A Notice of Project Change (NPC) was submitted to EOEA in June 2004 to initiate this process. Each of the alignment alternatives submitted in the 2004 NPC had in common a Core Tunnel Segment from South Station that follows Essex and Boylston Streets to Boylston Station, with a turnaround loop at the intersection of Charles and Boylston Streets. The following alternative alignments from the loop to a portal were presented in the 2004 NPC:

- Tremont Street alignment to a NEMC Portal
- Charles Street alignment to a NEMC Portal
- Charles Street alignment to an Elliot Norton Park Portal

(See Figure 2.3-13.)

In addition to serving the Washington Street corridor as far as Dudley Station, the project will also provide service to the Back Bay, providing a much needed connection from both areas to Downtown, the South Boston Waterfront, and Logan Airport. Throughout the development of the project, individuals and stakeholders have raised the concept of shifting the portal to a location closer to the Back Bay, making this connection more direct. Under such an alignment, the MBTA would still connect to Phase I service in Washington Street, but via a portal in the Columbus Avenue area, as opposed to a portal on Washington Street. Because this suggested alignment had not yet been fully studied or made available for public comment, it was not proposed as a full-fledged alternative in this NPC. However, as part of the SDEIS/EIR scoping process, the MBTA requested public comment as whether the Columbus Avenue Alternative should be included for detailed impact analysis in the SDEIS/EIR.

2.4 SDEIS/EIR Alternatives

The MBTA revised its candidate list of Silver Line Phase III alternatives for consideration in the SDEIS/EIR based on comments received on the 2004 NPC. The Charles Street alignment with a portal at Elliot Norton Park was eliminated from further consideration, due to its potential to create permanent adverse impacts to the park, and because of the availability of other alternatives that would meet the project's purpose and need with lesser potential for impacts. The Columbus Avenue Alternative was added to the list of SDEIS/EIR alternatives.

In addition, the FTA requested that the MBTA consider an additional alternative that combined elements of the Charles Street and the Tremont Street alignments, while entirely avoiding Elliot Norton Park. This alternative alignment (known as the Stuart Street alignment) extends south from the Boylston/Charles Street turnaround loop along Charles Street, turning east on Stuart Street, and then south on Tremont Street to the NEMC portal.

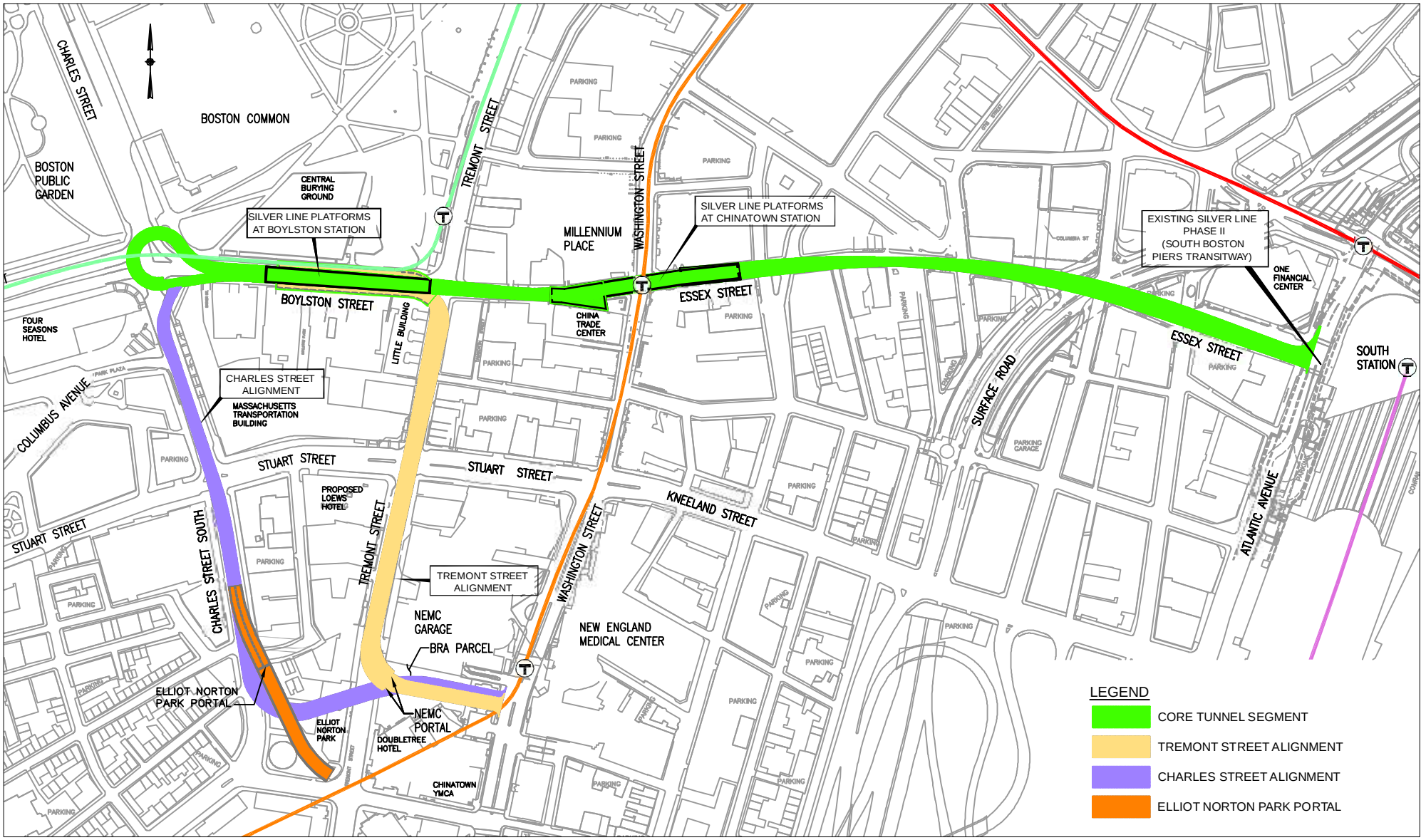

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Figure 2.3-13
2004 NPC Alternatives

The following lists the Build Alternative alignments and portals that are included for a detailed analysis in this SDEIS/EIR. Each of these alignment alternatives incorporates the Core Tunnel Segment.

- Tremont Street alignment to a NEMC Portal
- Charles Street alignment to a NEMC Portal
- Charles Street /Stuart Street /Tremont Street alignment to a NEMC Portal
- Columbus Avenue alignment to a Columbus Avenue Portal

A detailed description of each of the SDEIS/EIR alternatives is presented in Chapter 3.

Table 2.3-1 — Comparative Summary of Alternatives Considered

Alternative	South Station to Boylston Station* alignment	Chinatown Station	Boylston Station	Mid-Block Station	Turn around Loop	Boylston Station* to Portal Alignment	Portal Location	Comments/ Reasons For Elimination
1993								
1993 ROD Alignment	Essex Street, Avenue de Lafayette, Hayward Place, Avery Street	Under Avery Street	Under Boston Common	N/A	Under the Central Burying Ground, Boston Common	None	None	New development within ROW interferes with original alignment. Boston Common impacts.
2002								
2002 Preliminary Engineering Request Alignment	Essex Street, Boylston Street	Under Essex/ Boylston Streets	Under Boston Common	N/A	Under Boston Common	Tremont Street	Chinatown YMCA	Community impacts from taking YMCA. Boston Common impacts. High cost with an underground NEMC station.
2003 3rd Annual Update								
Group 1								
2003 New Starts	Essex Street, Boylston Street	Under Essex/ Boylston Streets	Under Boston Common, one platform	N/A	Under Boston Common	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	One platform at Boylston Station inadequate for ridership demand. Boston Common impacts.
Mid-Block/No Loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange Line	None	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand. No-Loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.
Mid-Block/ Bidirectional South Station loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange	South Station	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand. South Station bidirectional loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.
Mid–Block/Non-Revenue loop	*To Mid-Block Station - Essex Street, Boylston Street	N/A	N/A	Under Boylston Street w/ pedestrian connections to Green Line and Orange	Under Boston Common	* From Mid-Block Station - Tremont Street	Between NEMC garage and the Doubletree Hotel	Mid-Block Station insufficient to serve ridership projections and demand.
Group 2								
Revised 2003 New Starts	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boston Common, two platforms	N/A	Under Boston Common	Tremont Street	Between NEMC garage and the Doubletree Hotel	Boston Common impacts.
Tremont Street w/Stuart Street loop	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Tremont Street	N/A	Stuart Street	Tremont Street	Between NEMC garage and the Doubletree Hotel	Failure to meet grade/operational criteria due to location of Boylston Station and Stuart St. loop. High cost of impacts to Loews Hotel site.
Charles Street/ Elliot Norton Park portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles Street	Elliot Norton Park	Permanent, adverse impacts to Elliot Norton Park.
SDEIS/EIR Alternatives								
	Core Tunnel Segment					**Portal Alignments**		
Charles Street/ NEMC portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles Street	Between NEMC garage and the Doubletree Hotel	SDEIS/EIR alternative
Tremont Street /NEMC Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Tremont Street	Between NEMC garage and the Doubletree Hotel	2004 New Starts Alternative, SDEIS/EIR alternative
Stuart Street /NEMC Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Charles, Stuart, and Tremont Streets	Between NEMC garage and the Doubletree Hotel	SDEIS/EIR alternative
Columbus Avenue /Columbus Avenue Portal	Essex Street, Boylston Street	Under Essex/ Boylston Street	Under Boylston Street	N/A	Charles/Boylston Streets	Columbus Avenue	Columbus Avenue between Arlington and Berkeley Streets	SDEIS/EIR alternative

* Refers to mid-block station for those alternatives which propose a single mid-block station, since a separate Boylston Station would not be constructed.

CHAPTER 3.0 Alternatives Considered

3.1 Introduction

This chapter describes the physical and operational characteristics of the project alternatives evaluated in this Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR) for the Silver Line Phase III bus rapid transit (BRT) project. In compliance with Federal Transit Administration (FTA) guidelines, the specific alternatives evaluated include a No-Build Alternative, a Baseline Alternative, and the Build Alternatives.

As discussed in Chapter 2.0-*Evolution of the Silver Line Phase III Alternatives*, the Massachusetts Bay Transportation Authority (MBTA) has evaluated a number of alignment alternatives in response to a series of screening criteria: to avoid or minimize permanent impacts to important cultural and community resources (such as the Boston Common and the Chinatown YMCA);to respond to design, construction and operational considerations; to meet ridership demand related to the project purpose and need; and to reduce the overall cost of the project so as to make it more competitive for Federal funding. The Build Alternatives evaluated in this SDEIS/EIR represent feasible alternatives developed through that preliminary screening and evaluation process. The Notice of Project Change (NPC) and Notice of Intent (NOI) that initiated the scoping process for this SDEIS/EIR presented the following three Build Alternatives, each of which had a Core Tunnel Segment and turnaround loop in common, but differed in the balance of the tunnel alignment to a portal and ramp to grade: 1) Tremont Street Alignment with a portal at the New England Medical Center (NEMC); 2) Charles Street Alignment with a portal at NEMC; and 3) Charles Street Alignment with a portal at Elliot Norton Park. In addition, the MBTA requested public comment as to whether a Columbus Avenue Alignment Alternative should be considered. As a result of the public scoping process, the Charles Street Alignment with a portal at Elliot Norton Park was eliminated from consideration due to its potential for permanent adverse impacts to parkland, and the Columbus Avenue Alignment was added as one of the Build Alternatives to be considered. Following the scoping process, FTA requested that an alignment that followed Charles Street, Stuart Street and Tremont Street (the Stuart Street alignment) to a portal at NEMC also be considered as a Build Alternative.

Sections 3.2 and 3.3 of this chapter describe the No-Build and Baseline Alternatives in more detail. Section 3.4 describes the Build Alternatives; it provides a discussion of the Core Tunnel Segment and stations, together with each of the four alignments under consideration. Section 3.5 describes the operating plan, surface routes, and vehicle fleet requirements, while Section 3.6 discusses the potential ridership associated with the alternatives. Section 3.7 provides information on capital and operating costs for each alternative, while Section 3.8 discusses the project schedule.

3.2 No-Build Alternative

The No-Build Alternative includes future conditions that would exist if no transportation improvements associated with Silver Line Phase III were implemented. It provides the basis against which the environmental impacts of the other alternatives are evaluated. This alternative consists of Silver Line Phase I (currently in operation along Washington Street between Dudley Station and Downtown Crossing/Temple Place), and Silver Line Phase II (providing service from

South Station to the South Boston waterfront and residential areas and to Logan Airport)[1] It assumes that Silver Line Phases I and II would not be connected, and that they would continue to operate as separate services. The No-Build Alternative further consists of the transportation network contained in the Regional Transportation Plan for the year 2025, consistent with FTA planning policy and guidelines.

3.3 Baseline Alternative

This alternative serves as the FTA-approved baseline for quantifying the transportation and cost effectiveness of the Build Alternatives under the FTA New Starts process.[2] It represents a lower cost option as compared to the Build Alternatives that maximizes the use of existing transportation infrastructure. Under the Baseline Alternative, Phases I and II would remain as separate services, but revenue service on each would be increased to a level consistent with that proposed for Phase III operation. Peak headways for Phase I would be decreased from 4.0 minutes to 3.3 minutes. Phase II peak headways would decrease from 1.3 minutes to 0.8 minutes in the tunnel between South Station and the World Trade Center. Connections between Phases I and II would be made via transfer to and from the Red Line at Downtown Crossing Station (to access destinations along Washington Street) and at South Station (to access the South Boston waterfront and Logan Airport).

3.4 Build Alternatives

This section describes the Silver Line Phase III Build Alternatives considered in this SDEIS/EIR. The MBTA has developed a series of portal locations and route alignment alternatives that respond both to engineering and operational criteria and to the concerns of various stakeholders within the project area. Each of these alternatives has in common the Core Tunnel Segment, which connects to the existing Phase II tunnel in Atlantic Avenue, near South Station. The Core Tunnel Segment follows an alignment on Essex and Boylston Streets, extending to a turnaround loop at Charles Street. This Core Tunnel Segment configuration provides the option of connecting to any of the following alignments, with a portal either at the NEMC or on Columbus Avenue:

- Tremont Street Alignment/NEMC Portal
- Charles Street Alignment/NEMC Portal
- Stuart Street Alignment/NEMC Portal
- Columbus Avenue Alignment/Columbus Avenue Portal

(See Figure 3.4-1 for the alternative alignments.)

[1] Silver Line Phase II service to the Boston Marine Industrial Park (BMIP) and City Point in South Boston opened in December 2004; Sunday service to Logan Airport also began operation at the end of 2004. An additional route to Andrew Station via D Street as well as expanded service to Logan Airport will begin later in 2005

[2] FTA's New Starts process involves the evaluation and rating by FTA of projects seeking discretionary Section 5309 New Starts funding. This evaluation is conducted according to several key criteria related to a project's justification and financial feasibility. Chief among these criteria is cost effectiveness, which measures the annualized capital and operating cost of each build alternative divided by transportation system user benefits as compared to an FTA-approved Baseline Alternative. FTA defines transportation system user benefit as all annual travel-related benefits in terms of hours saved by all users of the transit system, including both existing riders and new riders. Cost effectiveness is a key measure used by FTA in the New Starts rating process – it accounts for half of the project justification rating assigned by FTA – and for this reason is a critical evaluation criterion for the Silver Line Phase III alternatives analysis.

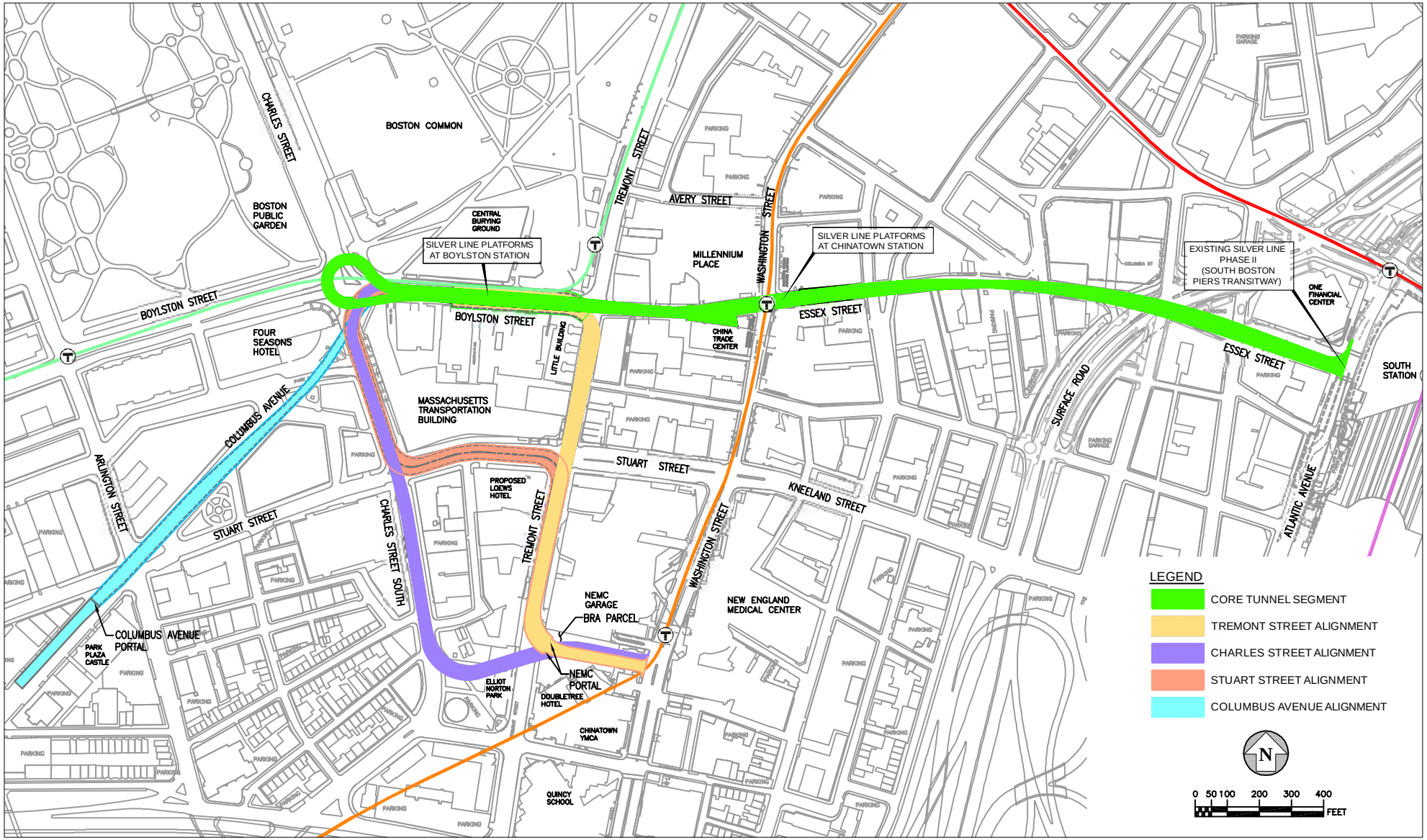

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Figure 3.4-1
SDEIS/EIR Phase III Alternatives

3.4.1 Core Tunnel Segment

The Core Tunnel Segment is substantially similar to the alignment studied in the 1993 *South Boston Piers/Fort Point Channel Transit Project Final Environmental Impact Statement/Final Environmental Impact Report* (FEIS/FEIR), for which the FTA issued a Record of Decision and the Massachusetts Executive Office of Environmental Affairs issued a Certificate of Adequacy (see Chapter 2.0 for additional discussion).

The 1993 FEIS/FEIR alignment extended in a tunnel, starting at South Station and extending west along Essex Street, then along Avenue de Lafayette. The alignment then traveled along Hayward Place, passing underneath the parcel proposed for the Hayward Place development. A new underground station was proposed near the intersection of Washington Street and Hayward Place, at which transfers could be made to Chinatown Station on the Orange Line via a pedestrian tunnel. From Hayward Place, the alignment continued west along Avery Street to a new station and platform one level below the existing Green Line Boylston Station platforms. A tunnel loop was proposed in the vicinity of the Central Burying Ground on the Boston Common to allow the vehicles to reverse direction and return to South Station.

At the time of the 1993 FEIS/FEIR, the Hayward Place/Avery Street station location was considered a preferred direct connection to the existing Orange Line Station. Due to the proposed large-scale mixed-use development then planned for the Hayward Place parcel, the MBTA and the Boston Redevelopment Authority (BRA) considered that location as a better opportunity to encourage transit-oriented development. That development project, however, has not progressed; in the meantime, the large Millennium Place project has been completed one block south, within the location of the original FEIS/FEIR alignment.

The Core Tunnel Segment for Phase III of the Silver Line described in this SDEIS/EIR relocates the originally proposed tunnel alignment to avoid interference with the Millennium Place development and to minimize disruption to the Boston Common. This segment now consists of approximately 3,000 feet of tunnel, extending along an Essex Street and Boylston Street alignment from the existing Silver Line Phase II tunnel in Atlantic Avenue near South Station to a turnaround loop under the intersection of Charles and Boylston Streets, west of the Boylston Silver Line Station. Operationally, this loop allows for the turnaround of outbound buses, as needed, to meet peak ridership demands to and from the South Boston Waterfront area. The loop will direct buses from the upper outbound tunnel to the lower inbound tunnel for their return to the Boylston Silver Line Station.

This Core Tunnel Segment connects to the existing Phase II tunnel in Atlantic Avenue near South Station with two tunnels in a side-by-side configuration. The inbound and outbound tunnels descend to pass under the New East Side Interceptor (NESI) sewer and the Dewey Square Tunnel, now reconfigured as the Central Artery southbound tunnel (CASB). Once west of the CASB, the individual single-lane inbound and outbound Phase III Silver Line tunnels in Essex Street transition to a stacked alignment, providing for a reduced construction influence zone. The alignment continues westerly within the Essex Street right-of-way (ROW), passing under the Chinatown Orange Line Station and Washington Street. A Chinatown Silver Line Station is proposed at this location with direct pedestrian connections to the Orange Line (see *Chinatown Station* below for description). From there the tunnels cross under Tremont Street, still in a stacked configuration within the Boylston Street ROW, passing adjacent to, but at a lower elevation than the existing Green Line tunnels and the Boylston Green Line Station. A Boylston Silver Line Station is proposed along Boylston Street west of Tremont Street with direct pedestrian connections to the Boylston Green Line Station (see *Boylston Station* below for description).

After the Boylston Station, the Core Tunnel Segment of the Silver Line Phase III terminates at a turnaround loop to be located within the ROW of the intersection of Charles and Boylston Streets. This revised core tunnel essentially takes the 1993 FEIS/FEIR Record of Decision alignment, and updates it to comply with the requirements of Federal Section 4(f) to do all possible planning to

avoid adverse impacts on Section 4(f) resources. In comparison to the 1993 alignment, the Core Tunnel Segment reduces impacts on the Boston Common, while achieving a straighter alignment consistent with the project goal of maintaining the flexibility to convert to light rail, should eventual passenger volumes require such a change. MBTA did conduct an analysis of the possibility of constructing only one combined Chinatown/Boylston Station and proceeding from Boylston Street to Tremont Street, using long underground pedestrian tunnels to connect to Boylston Street Station (see Appendix A). This variant does not meet project goals, and the MBTA considers the Core Tunnel Segment to be the logical result of improving the 1993 FEIS/FEIR alignment pursuant to Federal Section 4(f).

The Core Tunnel Segment, as improved, continues to have independent utility and could be beneficially implemented, with substantial transportation benefits as previously documented. However, the MBTA believes that even greater benefits are achieved by extending beyond this base alignment of a Core Tunnel Segment and turnaround loop to a portal that can link the Phase III tunnel to Phase I of the Silver Line to Dudley, while also providing for direct service to Back Bay.

From this base alignment of a Core Tunnel Segment and turnaround loop, there are four alternative routes that could link the Phase III tunnel to Phase I of the Silver Line along Washington Street: 1) Tremont Street Alignment with a portal at NEMC; 2) Charles Street Alignment with a portal at NEMC; 3) Stuart Street Alignment with a portal at NEMC; and 4) Columbus Avenue Alignment with a portal on Columbus Avenue between Berkeley and Arlington Streets. These alignment alternatives are described in more detail below in Sections 3.4.2 through 3.4.5.

3.4.1.1 Chinatown Station

The new Chinatown Silver Line Station will provide two platforms, each 220 feet in length and located along the Essex Street ROW below the existing Chinatown Station, which offer a free transfer connection to the Orange Line (see Figures 3.4-2a and 3.4-2b). The Silver Line tunnel alignment is stacked at this location due to ROW restrictions, resulting in two new underground levels at approximately 57 and 83 feet below the surface. The physical layout of the proposed station consists of two mined Silver Line tunnels, containing platforms, to pass below and perpendicular to the existing Orange Line station. Vertical circulation and ancillary spaces will be located at either end of the platform tunnels (and on either side of the Orange Line station) to provide all necessary connections between the Orange and Silver Lines. Silver Line passenger circulation will tie directly into that of the existing Orange Line, and Silver Line passengers will use the pre-existing Chinatown Station entry points. Modifications to the existing station will be necessary to provide enhanced egress requirements for station occupancy loads, as well as to provide optimal common entry to the station and connections between the Orange and Silver Lines.

Passenger circulation within the combined Orange Line/Silver Line station will consist of unobstructed, ADA (Americans with Disabilities Act) compliant pathways interconnecting all lobbies, platforms, and street entrances. Currently, the existing Orange Line lobbies are not connected to each other, and a patron wishing to reverse directions on the system must exit the station at the surface, cross Washington Street, and re-enter (and re-pay) to access the opposing platform. Under the proposed station layout, these existing lobbies will be connected by both the outbound and inbound Silver Line levels which pass beneath and perpendicular to the Orange Line platforms. The vertical circulation nodes, which “book-end” the Silver Line platforms, are located at either side of the existing Orange Line station and will collect all passengers and convey them to either the northbound or southbound Orange Line lobbies. Each node will contain stairs, elevators, and escalators providing ADA compliant connections. Signage will be a critical aspect to an efficient circulation scheme, and accessibility requirements will be met along all paths. Access from the street, both standard and ADA will remain as they exist today, with stairs and elevators leading directly to unpaid lobbies. Passengers, after paying fares, will be able to connect at the same level to the Orange Line platform, or to descend via the previously mentioned vertical circulation node to connect with the Silver Line platforms below. An additional

egress point is proposed to accommodate increased passenger volume as a result of the addition of Silver Line ridership. This egress only structure, which would connect directly to the existing Orange Line southbound lobby, would be located either on the plaza in front of the China Trade Building or at the basement within the China Trade Building itself. The Orange Line northbound currently contains adequate egress and will not require additional points of egress.

Several surface penetrations will be required for station and tunnel ventilation. Two emergency tunnel ventilation shafts are required, one at each end of the station. The easterly ventilation shaft would be located on the traffic island at the intersection of Harrison Avenue and Essex Street. The westerly ventilation shaft would be located on the plaza in front of the China Trade Building. Other station ventilation shafts are planned as surface grates within the sidewalk along Boylston and Essex Streets. These structures will be designed and placed with sensitivity to their urban surroundings and the flow of vehicular and pedestrian traffic (see Figure 3.4-3 for Chinatown Station surface elements).

3.4.1.2 Boylston Station

The new Boylston Silver Line Station will be located directly below and aligned with Boylston Street, and adjacent to the existing Green Line tunnel between Tremont Street and 134 Boylston Street. As a result of the narrow ROW, the Silver Line platforms will be stacked at this station. The main lobby, at 22 feet below grade, will be located at the east end of the station. Each platform will be 220 feet long, with the outbound platform at approximately 50 feet below grade and the inbound platform at approximately 76 feet below grade (see Figures 3.4-4a and 3.4-4b). A mezzanine level will provide access to both the Silver and Green Line platforms. Existing unused subway tunnels would be utilized to provide a convenient and direct connection from the mezzanine to the Green Line platforms at the existing Boylston Station. Modifications of the existing Green Line station will be required to provide this direct connection.

Passenger circulation within the combined Green Line/Silver Line station will consist of unobstructed, ADA compliant pathways interconnecting all lobbies, platforms, and street entrances. As is also the case at Chinatown Station, the existing Green Line lobbies are not connected; therefore efforts will be made to provide the most efficient connections possible. Under the proposed station layout, this connection would be provided by a common paid zone lobby located within or near the existing abandoned tunnels below the intersection of Tremont and Boylston Streets. From this central location at the adjoining ends of the proposed and existing stations, passengers can access all platforms within the station complex without incurring additional fares. Escalators and an elevator will serve the connection to both Silver Line levels below, and a separate elevator and escalator bank will provide a connection to the inbound Green Line platform. A pedestrian ramp (with ADA compliant slope and landings) will connect the lobby with the outbound Green Line platform through an existing maintenance vehicle storage tunnel. The existing tunnel will be upgraded to address passenger safety and security issues. All of these connections will occur within the paid zone and are ADA compliant. The proposed main access from street level to this common lobby will contain an unpaid-zone elevator for ADA compliance and will be located in the immediate area of the Boylston/Tremont intersection. The common lobby will also be accessible from the existing Green Line entry kiosks.

Passenger access to the Boylston Silver Line Station would utilize the area at the corner of the Little Building at 80 Boylston Street. General circulation will consist of escalators, stairs, and an ADA-compliant elevator at the east end of the station. Egress for emergency use only will be provided towards the west end of the station. The path of travel will be through a tunnel crossing under the existing Green Line alignment to a stair that will exit adjacent to the Deer Park maintenance area on the Boston Common; another egress location is proposed within the building at 120-124 Boylston Street, on the south side of the street. Proposed access improvements to the existing Green Line station include an elevator for the outbound platform, to be housed in a free-standing structure to the north of the existing Green Line outbound headhouse. (Elevator access to the inbound Green Line platform would be provided through the shared Silver Line/Green Line access in the corner of the Little Building.)

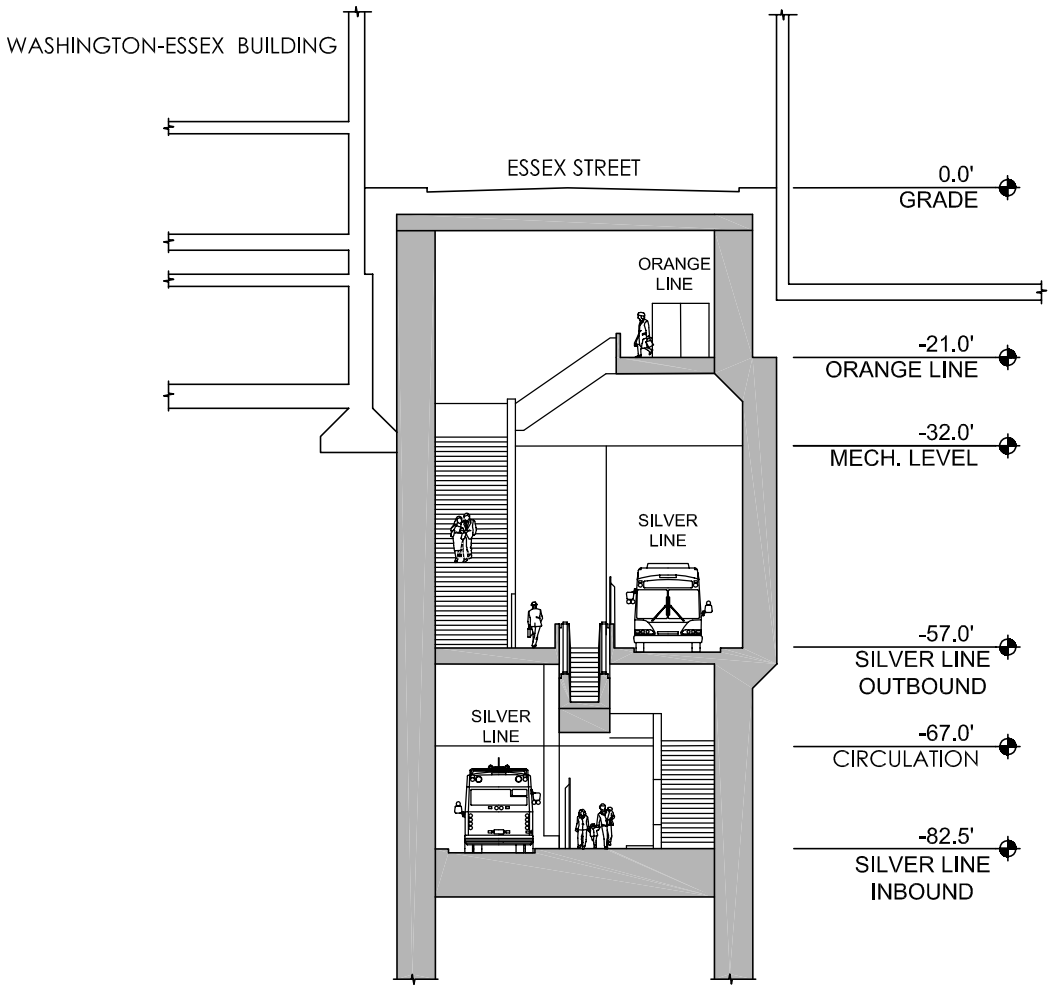

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Figure 3.4-2a
Cross-Section of Chinatown Station

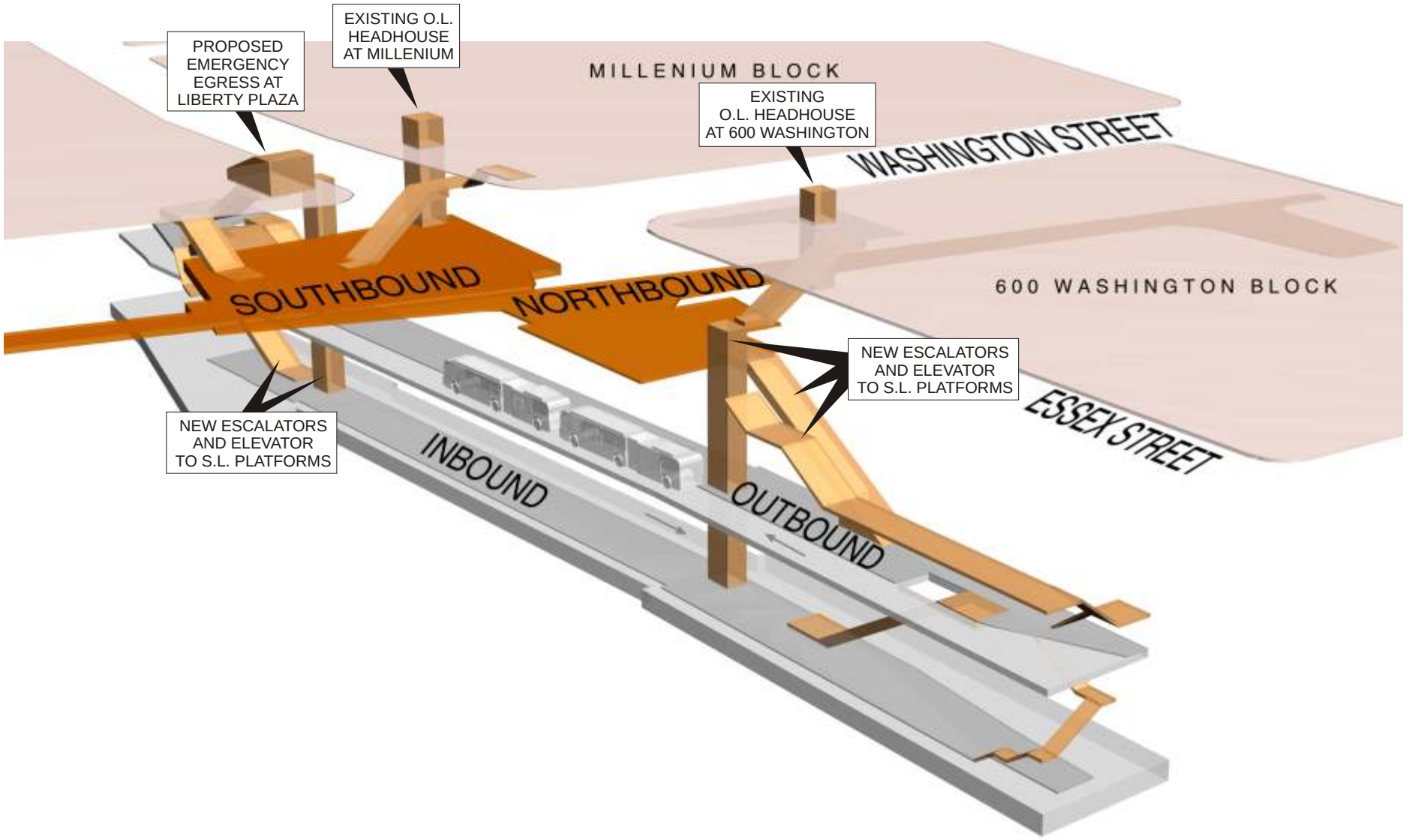

Figure 3.4-2b
Chinatown Station
Orange Line/Silver Line Connections

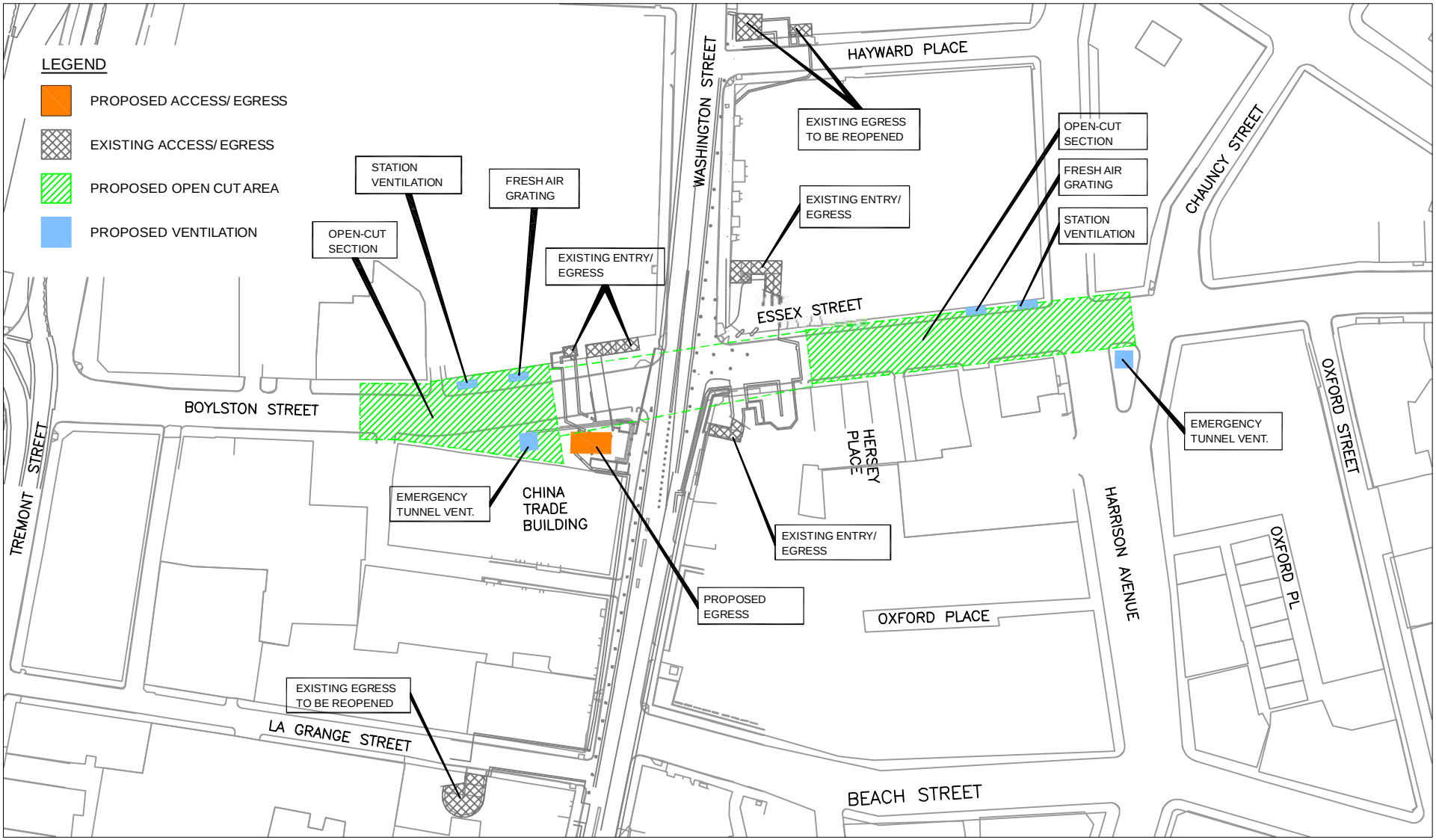

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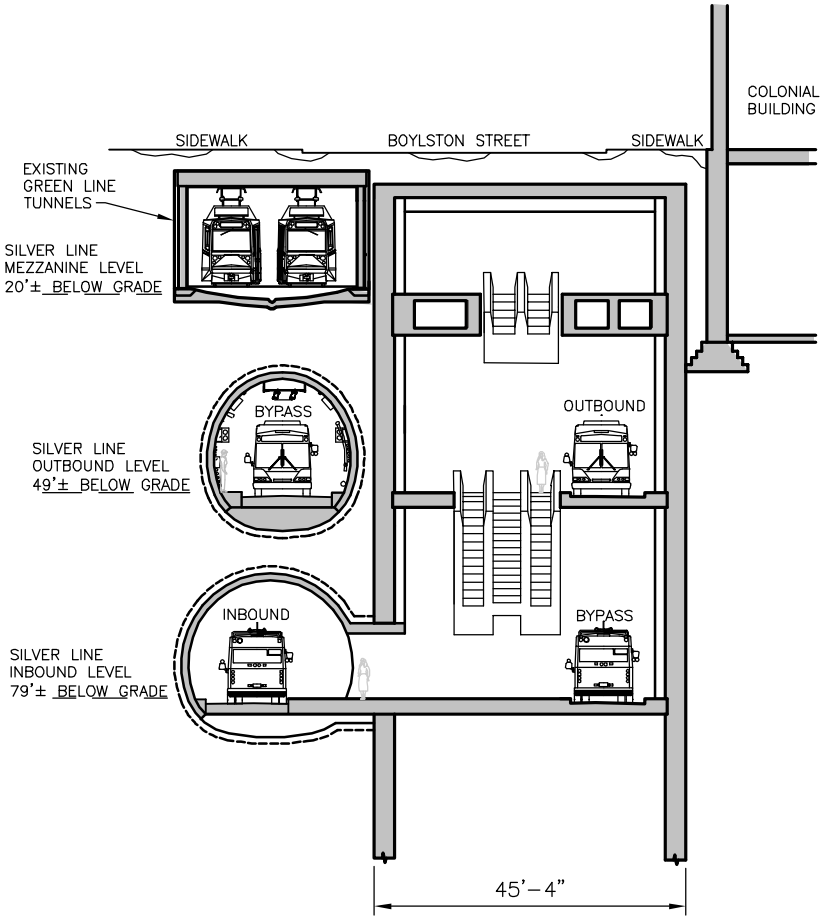
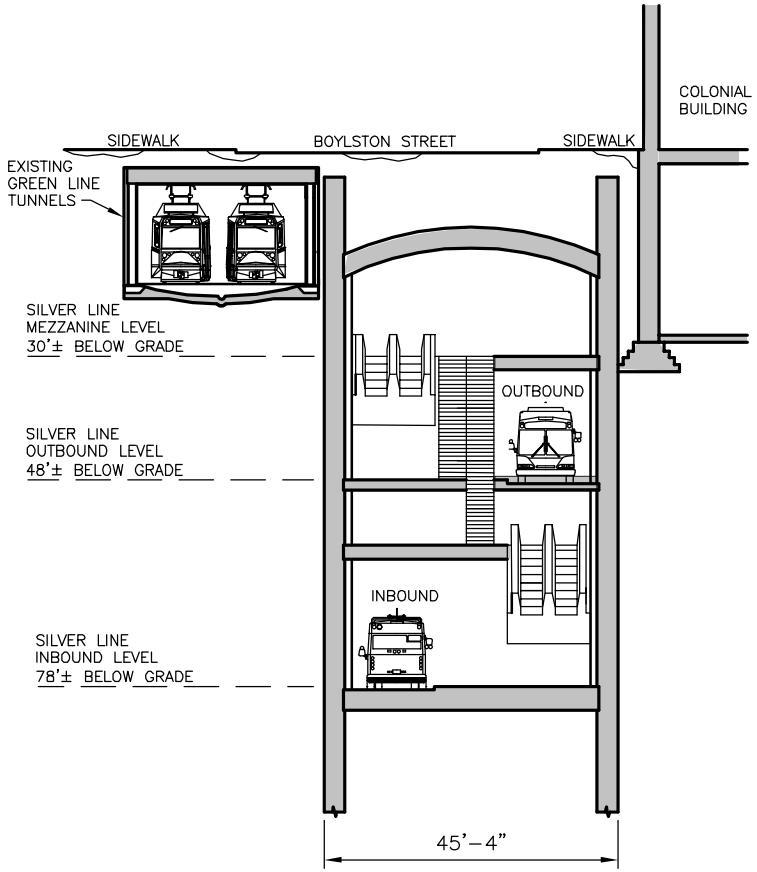
Figure 3.4-3
Chinatown Station Surface Elements



SILVER LINE – BOYLSTON STATION
(LOOKING EAST)
FOR TREMONT STREET ALIGNMENT



SILVER LINE – BOYLSTON STATION
(LOOKING EAST)
FOR CHARLES STREET SOUTH, STUART STREET,
AND COLUMBUS AVENUE ALIGNMENTS

Figure 3.4-4a
Cross-Section of Boylston Station

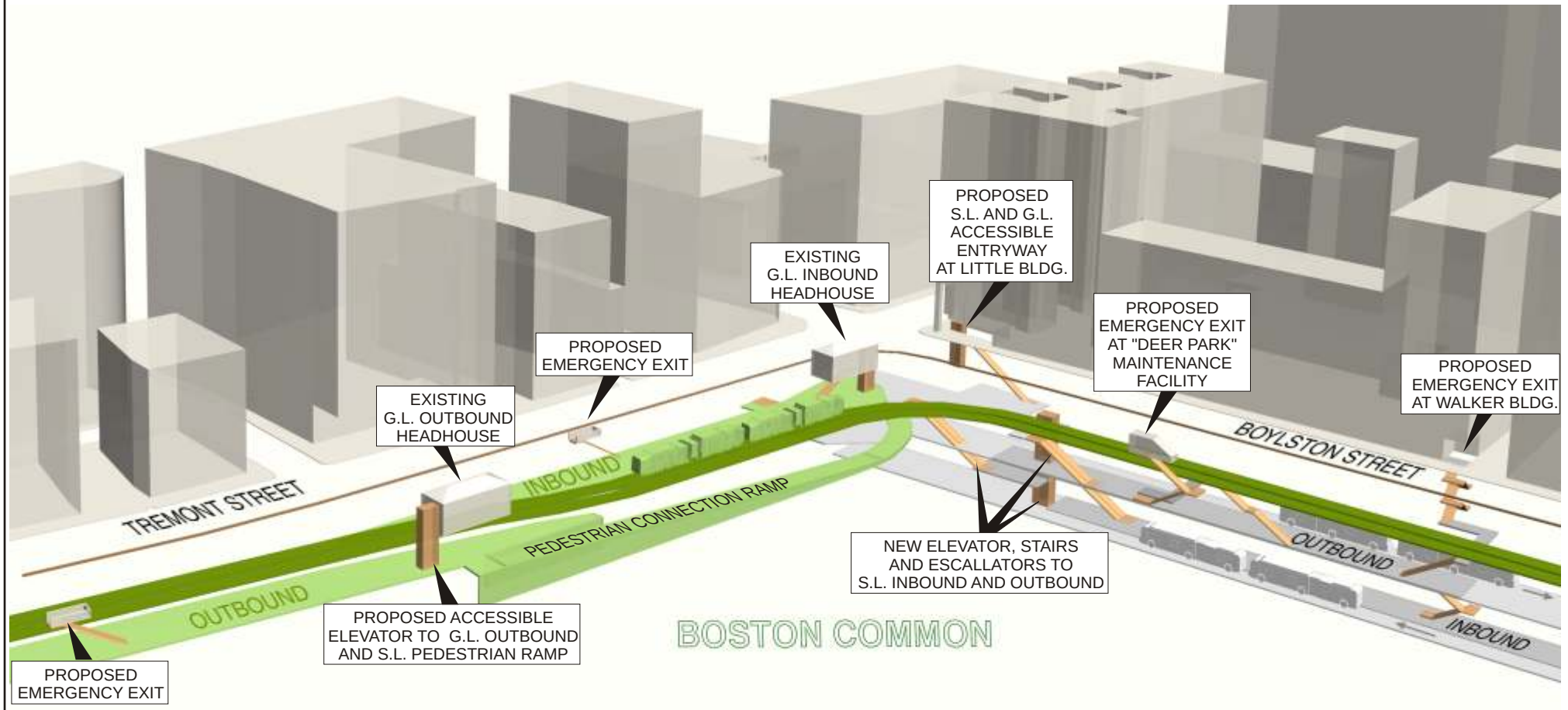


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Figure 3.4-4b
Boylston Station
Green Line/Silver Line Connections

In addition, two emergency egress stairs will be provided, utilizing a portion of the footprint of two former Green Line headhouses that were demolished circa 1960.[3] (See Figure 3.4-5 for the location of surface elements associated with Boylston Station.)

As part of the Tremont Street alignment, a pair of by-pass lanes would need to be incorporated into the station, providing through-service to the turn-around loop below the intersection of Charles and Boylston Streets for revenue operations. These by-pass lanes would expand the width of the station envelope to the north, below and parallel to the existing Green Line tunnel along Boylston Street. These by-pass lanes would not be required for the remaining Build Alternatives – Charles Street, Stuart Street, Columbus Avenue. In the latter alternatives, the turn-around loop would only be used for non-revenue service.

In addition to access and egress requirements, the Silver Line Boylston Station will require ventilation shafts. The emergency ventilation shaft at the easterly end of the station will tie into the existing Green Line ventilation shaft located at the southeast corner of the Deer Park maintenance facility yard. An additional ventilation structure would be provided at the southeast corner of the Charles Street and Boylston Street intersection. Fresh air ventilation for the station would be provided through at-grade vent structures on the south side of Boylston Street in the sidewalk adjacent to the State Transportation Building. These structures will be designed and placed with sensitivity to their urban surroundings and the flow of vehicular and pedestrian traffic.

3.4.2 Tremont Street Alignment/NEMC Portal Alternative

The Tremont Street Alignment/NEMC Portal Build Alternative connects to the Core Tunnel Segment at the intersection of Boylston and Tremont Streets, and it extends south within the Tremont Street ROW to a portal and ramp to grade located between the NEMC garage and the Doubletree Hotel (the NEMC Portal); via this portal, the alignment would connect to Phase I Silver Line service (see Figure 3.4-6). A surface stop would be provided just west of Washington Street within the Silver Line ROW.

At the northern end of the alignment near Boylston Station, inbound and outbound tunnels are located within the Tremont Street ROW in a stacked arrangement. The tunnels transition to a side-by-side configuration at approximately LaGrange Street. The tunnels continue in a side-by-side configuration in Tremont Street to a point adjacent to the NEMC parking garage. The alignment then turns to the east as it ramps up at a grade of 5.6%, to a tunnel portal located east of the Tremont Street ROW line. The alignment continues to the east in a boat section, an inclined roadway transitioning from the tunnel to a surface elevation. There are concrete walls approximately 18 inches in thickness from the roadbed to the surface within the boat section. These walls act to retain earth and the entire structure resembles an open-roofed ramp descending from a surface grade to a tunnel opening. The boat section passes through BRA and Doubletree Hotel properties (currently used for parking), ending at Washington Street between the Doubletree Hotel and south of the NEMC garage. The portal entrance will have a two gate system similar to the Silver Line Phase II D Street portal. One of the gates will be made out of steel and will have a lock.

[3] The graphic identifies locations of emergency egress-only stairs on the Boston Common. These stairs as proposed would be exposed to the weather, with only a knee-wall around the perimeter. However, the MBTA, in conjunction with the Boston Landmarks Commission, will seek approval from the Massachusetts Department of Public Safety (DPS) to allow the use of a pop-up hatch instead of the open stairwell to reduce visual impacts to Boston Common. This is a covered opening flush with the ground, with a hatch that would be opened from within in case of emergency. On other Green Line accessibility projects in significant historic resource areas (most notably Copley Station outside the Boston Public Library), the MBTA received approval to use pop-up hatches. For the purpose of this environmental review, the MBTA is showing the stairways with knee walls, in the event that DPS does not approve the pop-up system on Boston Common for emergency egress for Boylston Station, as it represents a worst case with regard to visual impacts on Boston Common.

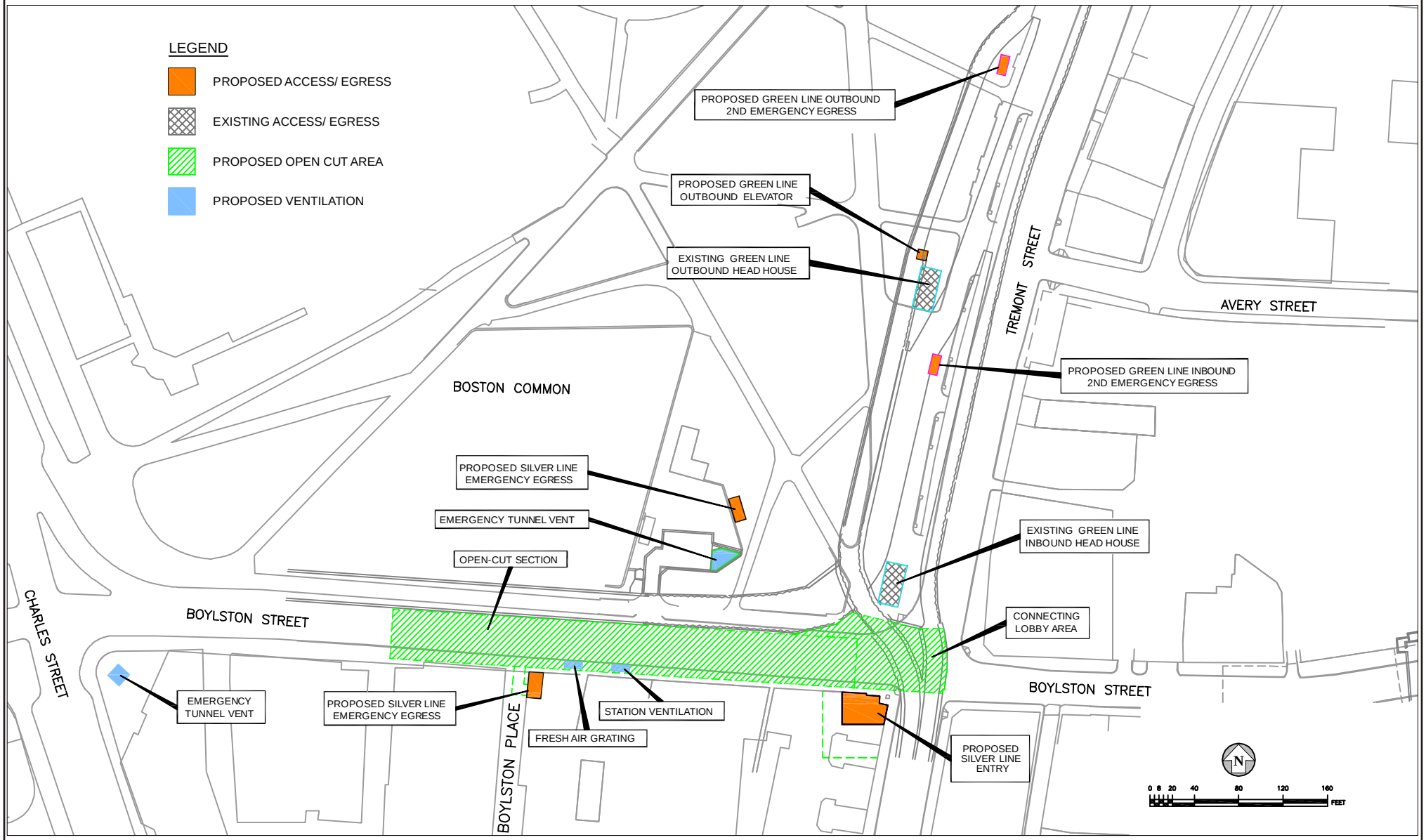

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Figure 3.4-5
Boylston Station Surface Elements

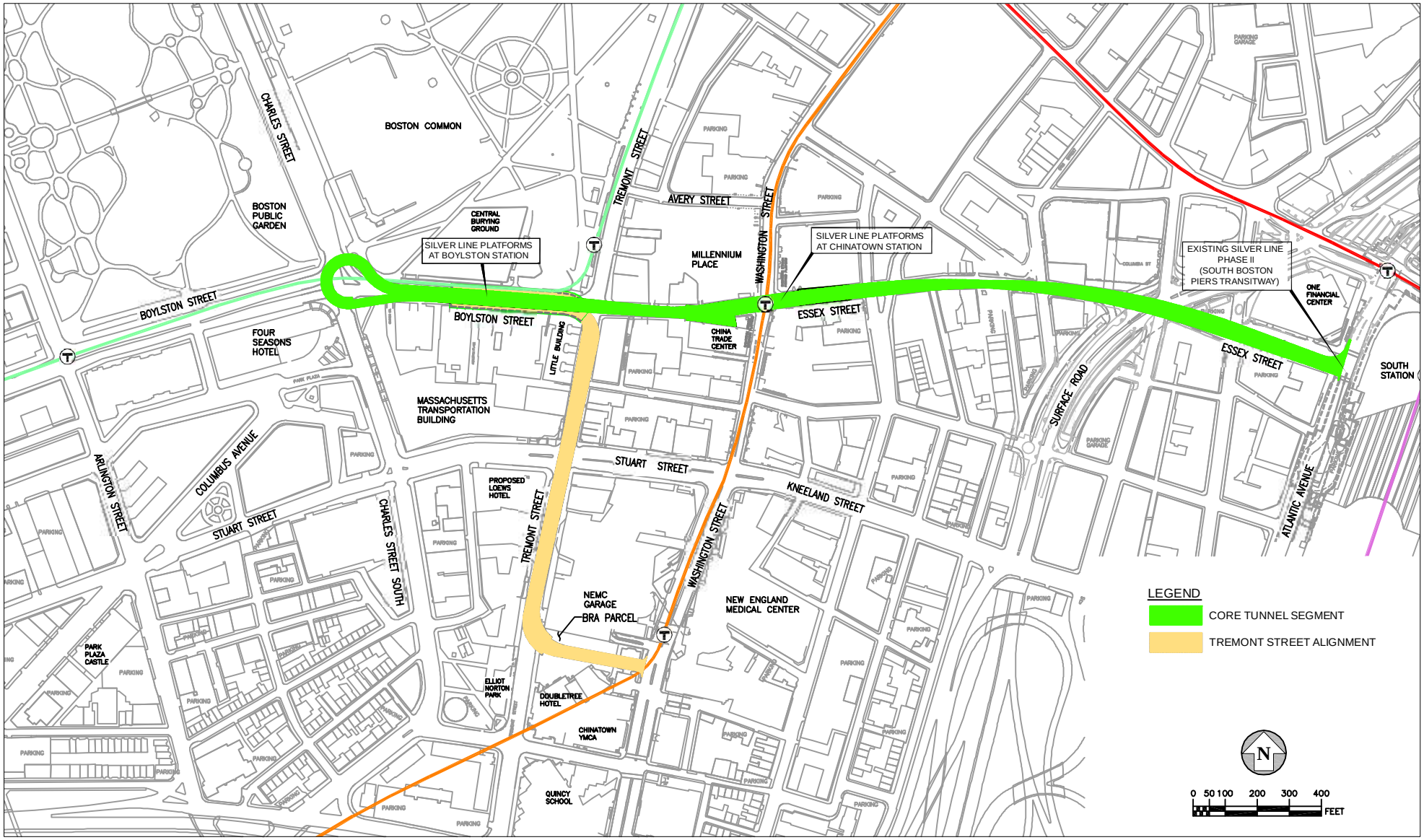

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Figure 3.4-6
Tremont Street Alternative

This gate will be used during non-revenue hours to keep the tunnel secure. A second gate will be made from a much lighter material that opens and closes for each passing vehicle during revenue hours. This second gate is used only as a warning for approaching unauthorized vehicles not to enter.

Off-street surface bus stops would be provided at NEMC in the portal boat section within the Silver Line ROW. The overhead catenary wire providing power to the vehicles in the tunnel would end at the NEMC stop, where the vehicle would change from electric to diesel-powered GenSet mode. The vehicle would operate in diesel mode on Washington Street, and therefore there would be no catenary wire on Washington Street itself. (A complete description of the Silver Line BRT vehicle is provided in Section 3.5.3.1.) A bypass lane would be provided at the NEMC stop to allow either an inbound or outbound vehicle to bypass another vehicle at the stop to provide operational flexibility (see Figure 3.4-7). The length of the proposed Silver Line Phase III Tremont Street Portal Alignment extending from the Core Tunnel Segment to the Washington Street intersection is approximately 1,420 feet, not including the bypass lane required at Boylston Station for this alternative.

This portal alignment alternative would require the demolition of the abandoned Tremont Street Subway Tunnel located within the public ROW between Boylston and Oak Streets. This tunnel was constructed in 1897, as part of the first subway system in the United States and is considered Eligible for Listing on the National Register of Historic Places. (See Chapter 4 for additional discussion.) Because the presence of the existing Tremont Street Subway Tunnel precludes the use of mining as a viable construction method, this alternative alignment would need to be constructed by a cut-and-cover method along its entirety, with an attendant increase in construction phase disruption to traffic and abutters. (See Chapter 6 for additional discussion of construction methodologies.) The Tremont Street Alignment /NEMC Portal Alternative avoids any impacts to parklands.

3.4.3 Charles Street Alignment/NEMC Portal Alternative

The Charles Street Alignment/NEMC Portal Build Alternative consists of a tunnel that extends south from the Core Tunnel Segment along Charles Street, to a portal located between the NEMC garage and the Doubletree Hotel (see Figure 3.4-8). The tunnel alignment would be located within the Charles Street ROW in a stacked arrangement, transitioning to a side-by-side arrangement before crossing under Elliot Norton Park south of Warrenton Place, thereby avoiding the homes on Lyndeboro Place. The tunnel then crosses under Tremont Street ascending to a portal in and ramp to grade between the Doubletree Hotel and the NEMC garage where the alignment will connect to Phase I Silver Line service running on the surface along Washington Street. A NEMC surface station would be provided within the Silver Line ROW, just west of Washington Street, as described in Section 3.4.2 (see Figure 3.4-7).

The length of the proposed Silver Line Phase III Charles Street Portal Alignment extending from the Core Tunnel Segment to the Washington Street intersection is approximately 1,935 feet.

The tunnel segment within Charles Street would be mined, thereby reducing the potential for impacts to traffic and abutters at the surface. The tunnel segment through Elliot Norton Park is shallower as it approaches the portal, requiring construction by a cut-and-cover method. This will result in construction phase impacts to the park; however, the park will be fully restored once the construction of this segment of the tunnel is completed. The Charles Street Alignment/NEMC Portal Alternative avoids permanent impacts to parkland. (See Chapter 4 for additional discussion of impacts and Chapter 6 for additional discussion of construction methodologies.)

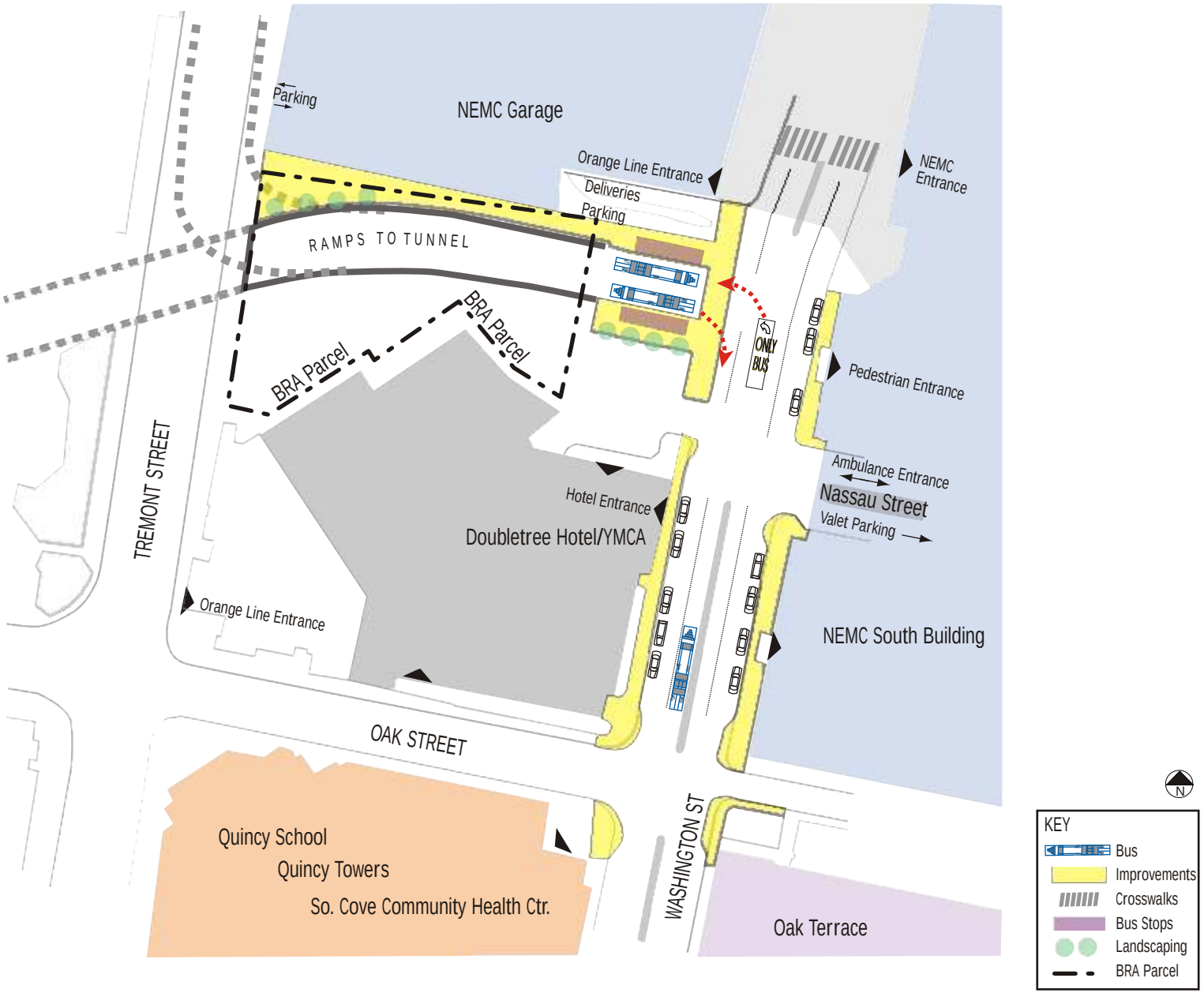
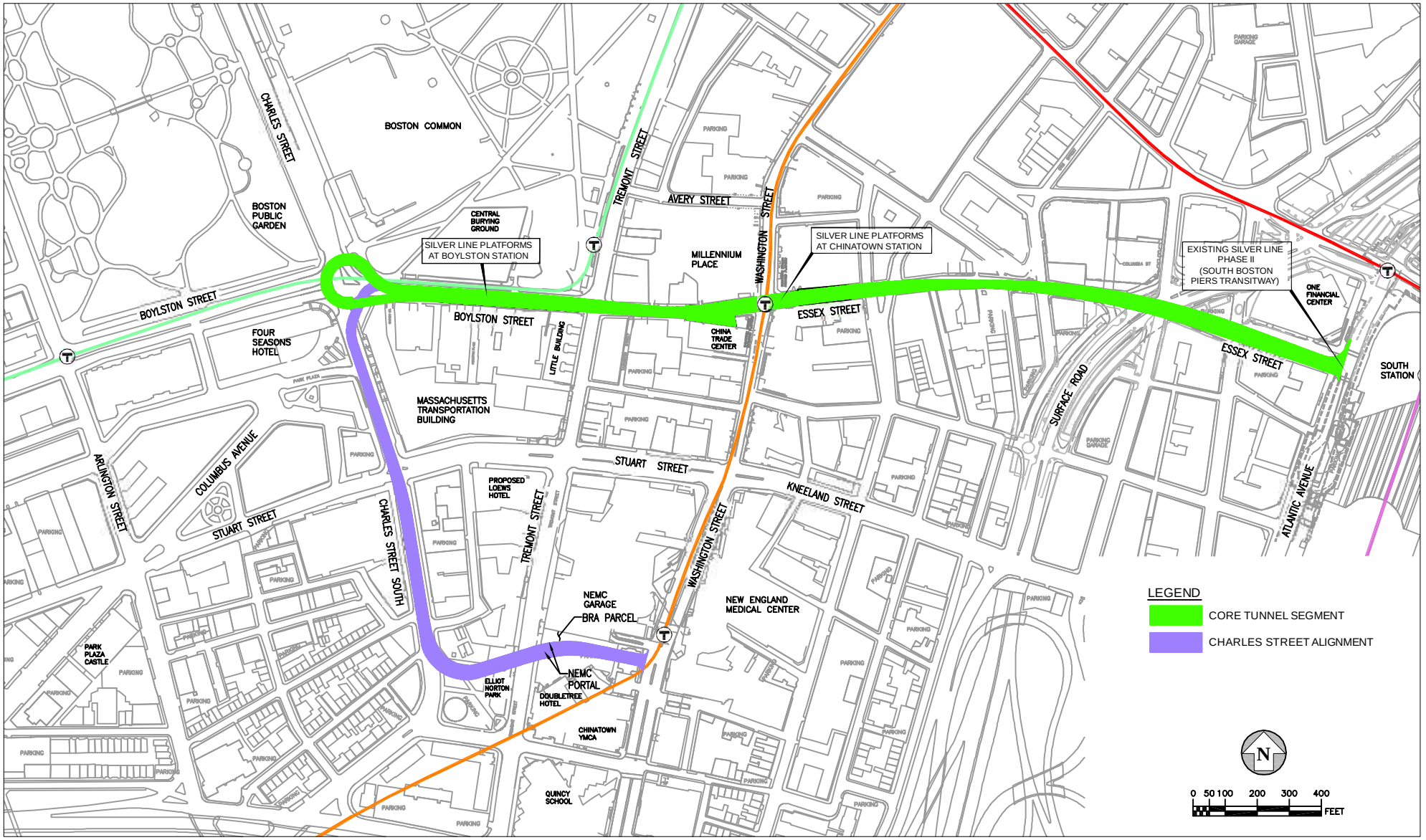


Figure 3.4-7
New England Medical Center (NEMC) Portal



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SILVERLINE

Figure 3.4-8
Charles Street Alternative

3.4.4 Stuart Street Alignment/NEMC Portal Alternative

The Stuart Street Alignment/NEMC Portal Build Alternative combines elements of the Charles Street and Tremont Street alignments. This alternative alignment extends from the Core Tunnel Segment at the Boylston Street and Charles Street intersection south along the Charles Street ROW in a stacked tunnel arrangement and a slight upward gradient. The tunnels turn easterly under Stuart Street staying within the ROW in a stacked arrangement. The Silver Line inbound and outbound tunnels begin to transition to a side-by-side arrangement within Stuart Street and are in a final side-by-side arrangement after they turn the corner from Stuart Street south onto Tremont Street. The inbound tunnel gradient increases to approximately 4% in Stuart Street and remains constant until increasing again at the portal. The alignment then follows the Tremont Street Alignment in a parallel tunnel arrangement, turning east near the NEMC parking garage, where it ramps up at a grade of 5.6% passing though the BRA and Doubletree properties currently used for parking to a tunnel portal located east of the Tremont Street easterly ROW line. The alignment continues to the east in an open boat section, ending at Washington Street at a point north of the Doubletree Hotel and south of the NEMC garage (see Figure 3.4-9) where the alignment will connect to Phase I service on Washington Street. Inbound and outbound bus stops will be provided at the NEMC portal (see Figure 3.4-7). The length of the proposed Silver Line Phase III Stuart Street Alignment extending from the Core Tunnel Segment to the Washington Street intersection is approximately 2,130 feet.

The Stuart Street Alignment would be mined along Charles Street and Stuart Street, and constructed by a cut-and-cover method along Tremont Street. It avoids the temporary construction impacts to Elliot Norton Park associated with the Charles Street alignment, and reduces the amount of demolition of the existing historic Tremont Street Subway tunnel and cut-and-cover construction associated with the Tremont Street alignment.

3.4.5 Columbus Avenue Alignment/Columbus Avenue Portal Alternative

The Columbus Avenue Alignment and Portal Build Alternative extends from the Core Tunnel Segment at the Boylston Street and Charles Street South intersection southwest under Charles Street South and Park Plaza within the Columbus Avenue ROW in a stacked arrangement, transitioning to a side-by-side configuration prior to the Arlington Street intersection. Continuing westerly, both the inbound and outbound tunnels extend to a portal west of Arlington Street. The alignment then rises to the surface on a 6% gradient, meeting grade east of the Berkeley Street intersection adjacent to the Salvation Army Headquarters (see Figure 3.4-10). The portal entrance will have a two gate system similar to the Silver Line Phase II D Street portal. One of the gates will be made out of steel and will have a lock. This gate will be used during non-revenue hours to keep the tunnel secure. A second gate will be made from a much lighter material that opens and closes for each passing vehicle during revenue hours. This second gate is used only as a warning for approaching unauthorized vehicles not to enter. A surface stop would be located beyond the top of the ramp for all outbound vehicles. Bus stops would be located on Berkeley Street south of Columbus Avenue for inbound Dudley service and on Columbus Avenue west of Berkeley Street for inbound Back Bay service. All inbound and outbound vehicles would change from electric to diesel mode at the top of the ramp, east of Berkeley Street. The catenary would end at Berkeley Street and not continue through the intersection. This portal alternative does not provide the option of a bypass lane at the mode-change location for either inbound or outbound vehicles. (See Figure 3.4-11.) The length of the proposed Silver Line Phase III Columbus Avenue Portal Alignment extending from the Core Tunnel Segment to the Columbus Avenue outbound bus stop is approximately 1,625 feet.

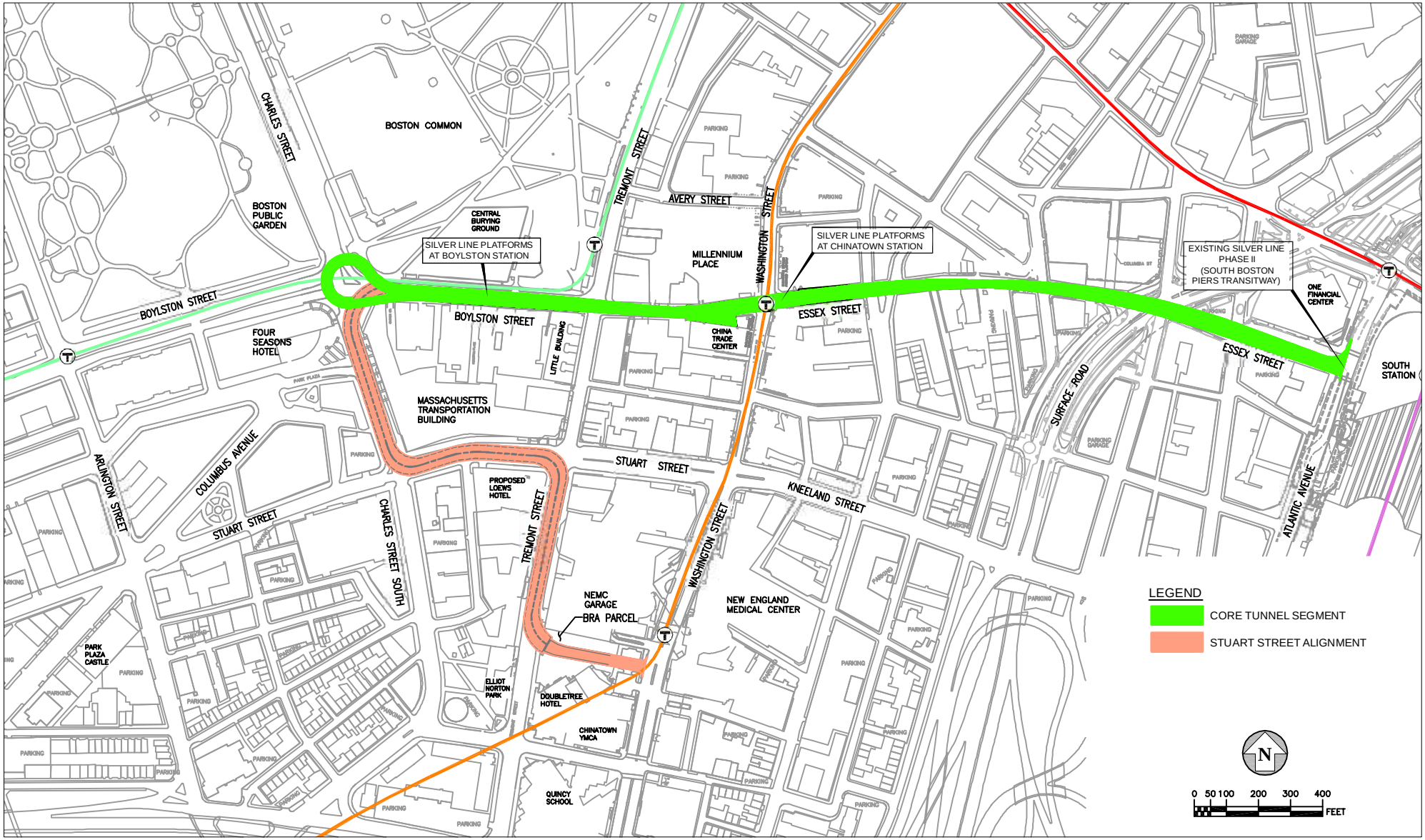

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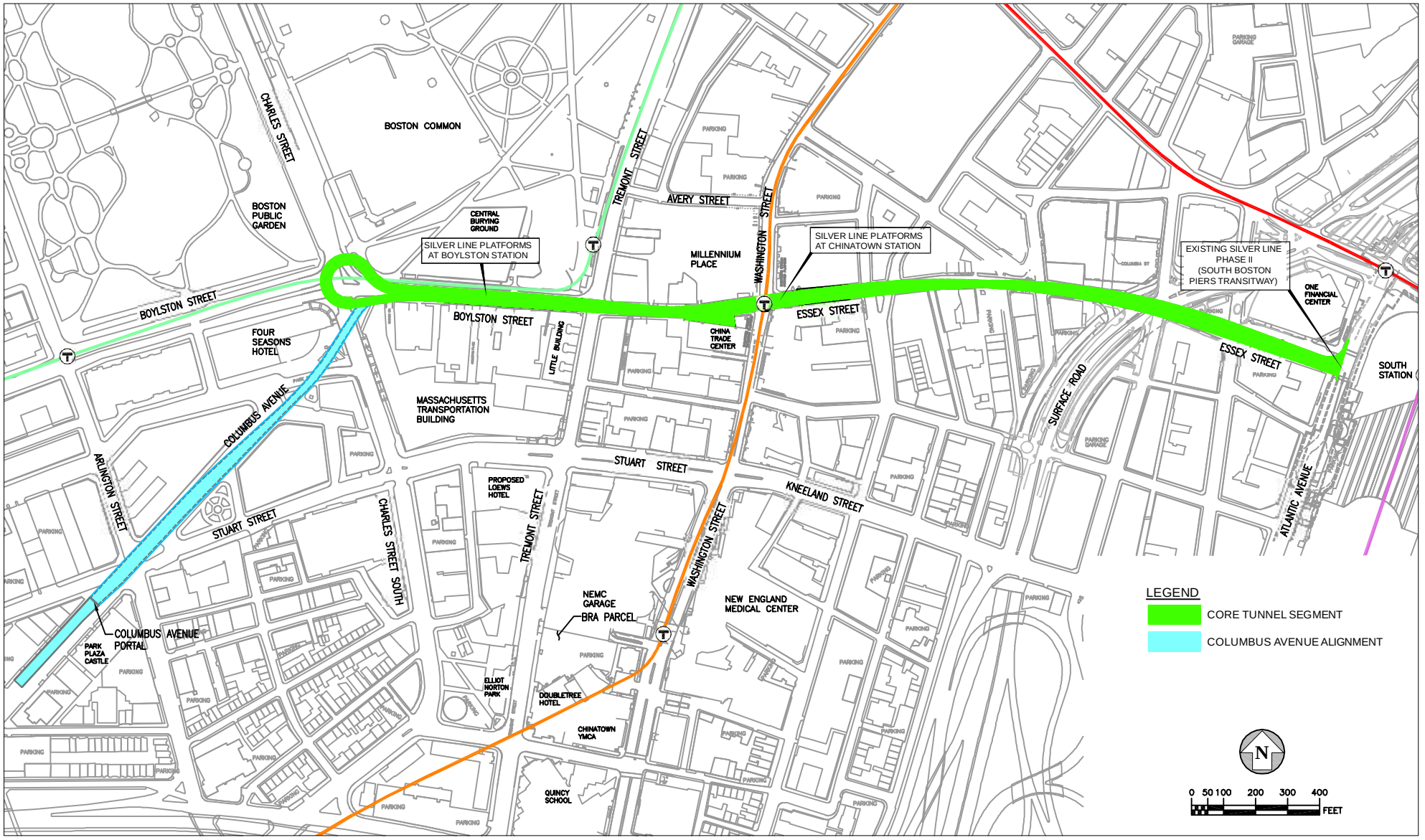
Figure 3.4-9
Stuart Street Alternative



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

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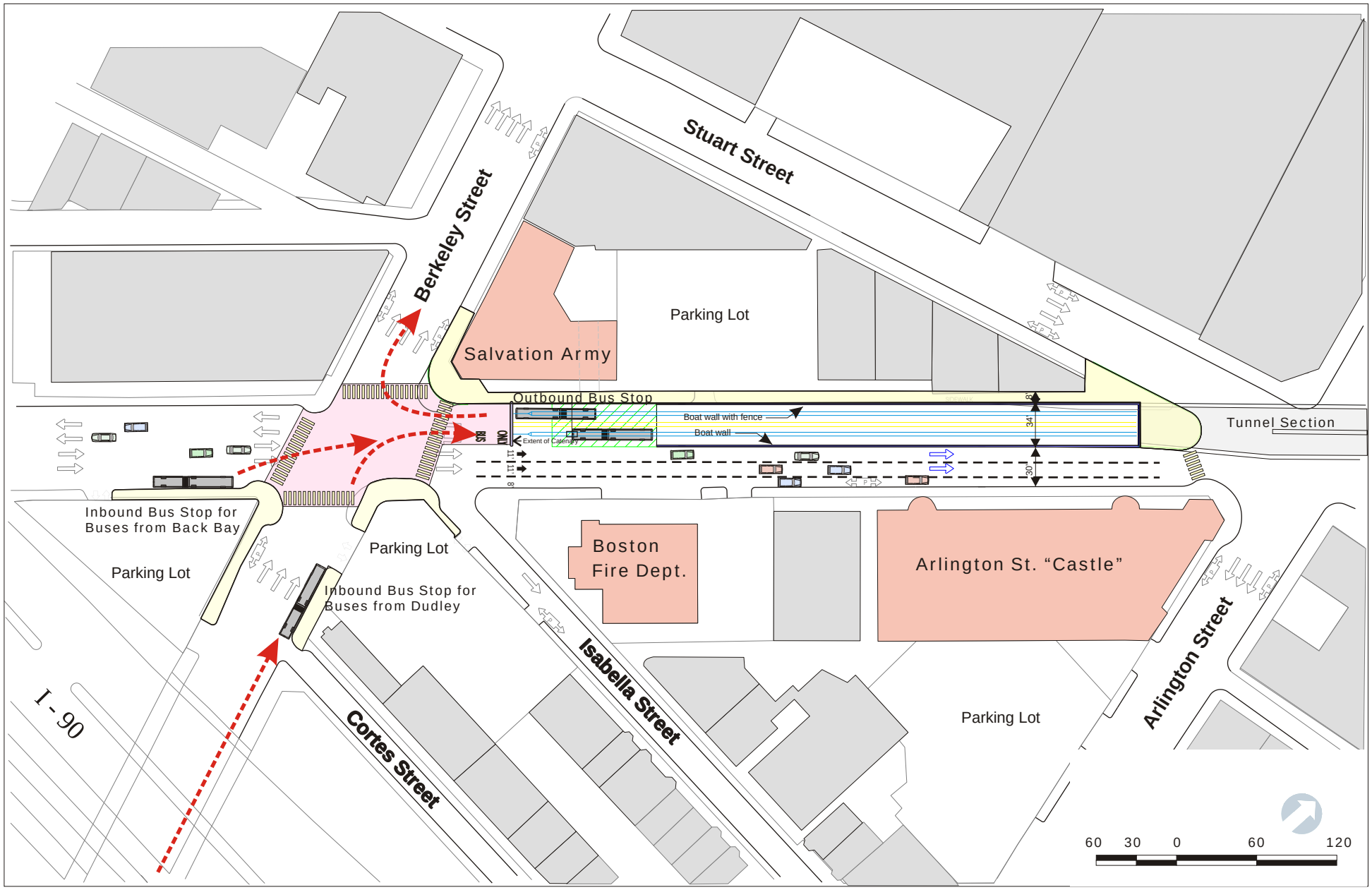
Figure 3.4-10
Columbus Avenue Alternative



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 3.4-11
Columbus Avenue Portal

The Columbus Avenue Alignment and Portal Alternative would eliminate the two westbound travel lanes of Columbus Avenue between Arlington and Berkeley Streets (see Chapter 5 for a discussion of traffic impacts). This alternative would be constructed by a cut-and-cover method from the portal to a point approximately 250 feet east of the Arlington Street/Columbus Avenue intersection. From that point to the Core Tunnel Segment, the Columbus Avenue tunnel would be mined, thereby reducing the potential for impacts to traffic and abutters at the surface during construction. The Columbus Avenue portal route alignment avoids any impacts to parklands. However, there would be potential impacts to several National Register-eligible structures adjacent to the portal location.

See Chapter 5 for additional discussion of impacts and Chapter 6 for additional discussion of construction methodologies for the Columbus Avenue Alignment and Portal Alternative.

3.4.6 Comparative Summary of Portal Alignments

Table 3.4-1 provides a comparative summary of the portal alignments under consideration for Silver Line Phase II.

Table 3.4-1 – Comparative Summary of Portal Alignments

Alternative	Portal Location	Length*	Boylston Station	Turnaround Loop***
Tremont Street Alignment/ NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	1,420 feet of tunnel in Tremont Street, plus 840 feet of bypass lane at Boylston Station ** Total: 2,260 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. Bypass lane provided at Boylston Station.	Within roadway ROWs at Charles and Boylston Streets. Used for revenue service.
Charles Street Alignment / NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	1,935 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-revenue service.
Stuart Street Alignment/ NEMC Portal	Between Doubletree Hotel and NEMC garage- Provides for a bypass lane	2,130 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-revenue service.
Columbus Avenue Alignment/ Columbus Avenue Portal	In Columbus Avenue between Arlington and Berkeley Streets- No bypass lane	1,625 feet	In Boylston Street ROW between Tremont and Charles Streets w/pedestrian tunnel connection to existing Green Line Boylston Station. No bypass lane.	Within roadway ROWs at Charles and Boylston Streets. Non-revenue service

* The length of each alignment alternative is measured from the turnaround loop associated with the Core Tunnel Segment at the intersection of Boylston and Charles Streets..

** The configuration of the Tremont Street alignment requires a bypass lane at Boylston Station to allow Silver Line vehicles to change direction at the turnaround loop during revenue service for inbound and outbound service (see Figure 3-4.4). The length of the bypass is included to provide for an equivalent comparison of alternatives.

*** Non-revenue service refers to the bus using the turnaround loop without passengers on board.

3.5 Operating Plan and Fleet Requirements

3.5.1 No-Build and Baseline Alternatives Operating Plan

The No-Build Alternative assumes that Silver Line Phase I and Phase II would remain as separate services, with Phase I operating on 4-minute peak headways, and Phase II operating on 2-minute peak headways.

In the case of the Baseline Alternative, Silver Line Phase I and Phase II would still remain as separate services, but revenue service on both would be increased to a level consistent with that proposed for Phase III operation. Phase I (Dudley Square to Downtown Crossing) peak headways would be decreased from 4 minutes to 3.3 minutes. Phase II peak headways would decrease from 1.3 minutes to 0.8 minutes in the tunnel between South Station and the World Trade Center. A new service from Back Bay to Downtown Crossing would be added. Connections between Phases I and II would be made via a transfer to and from the Red Line at Downtown Crossing Station (to access destinations along Washington Street) and at South Station (to access the Waterfront and Logan Airport).

To ensure that the Baseline Alternative is consistent with service proposed for the Phase III Build Alternatives, the same routes and headways are assumed for the Phase I corridor, in the Phase II tunnel, and on surface routes, including a surface route from Dalton Street in the Back Bay to Downtown Crossing. The proposed routes and headways for the Baseline Alternative, which have been equilibrated to future ridership demand, are as follows:

- Dudley to Downtown Crossing: 3.3-minute headway
- South Station to Logan Airport: 3.3-minute headway
- South Station to Boston Marine Industrial Park (BMIP) 10-minute headway
- South Station to City Point 10-minute headway
- South Station to Boston Convention and Exhibition Center (BCEC) and Andrew Station via D Street 5-minute headway
- South Station to Silver Line Way[4]: 1.9-minute headway
- Back Bay (Dalton) to Downtown Crossing: 10-minute headway

3.5.2 Build Alternatives Operating Plan

The operating plan for the Silver Line Phase III Build Alternatives consists of nine routes, of which three originate at Dudley Square, one originates at Dalton Street in the Back Bay, and five originate at Boylston Station. (See Figure 3.5-1.) This operating plan provides service through the new Phase III tunnel, and maintains one Silver Line surface route via Washington Street between Dudley Square and Downtown Crossing (Temple Place) in response to the existing high ridership on the Phase I service. The Back Bay route will serve anticipated travel demand between Back Bay activity centers (such as hotels) and the new BCEC in the waterfront area. The operating plan would be the same for either the Tremont Street, Charles Street, or Stuart Street Alignments (connecting to the NEMC Portal), or the Columbus Avenue Alignment and Columbus Avenue Portal; the only difference is in the surface routes from the respective portal locations to Dudley or Back Bay. Due to the location of the portal, the Columbus Avenue Alternative would not serve the NEMC stop for those routes that utilize the tunnel; however, service to NEMC would be provided via the Dudley to Downtown Crossing service. Sections

[4] Previously known as the "Connector Road," it extends east of the Silver Line Phase II portal between D Street and the Massport Haul Road.

3.5.2.1 and 3.5.2.2 provide a description of the Dudley and Back Bay surface routes for each of the portal options.

Peak-hour headways for the nine routes are as follows:

- Dudley to Logan: 10-minute headway
- Dudley to Silver Line Way: 10-minute headway
- Dudley to Downtown Crossing (Temple Place): 6-minute headway
- Back Bay (Dalton Street) to Silver Line Way: 10-minute headway
- Boylston to Logan: 5-minute headway
- Boylston to BMIP: : 10-minute headway
- Boylston to City Point: 10-minute headway
- Boylston to BCEC and Andrew Station via D Street: 5-minute headway
- Boylston to Silver Line Way: 3-minute headway

The peak-period levels of service provided on these routes correlate to a Silver Line bus providing service from Dudley approximately every three minutes, a bus from Boylston every minute, and a bus from the Back Bay every 10 minutes.

3.5.2.1 NEMC Portal Surface Routes

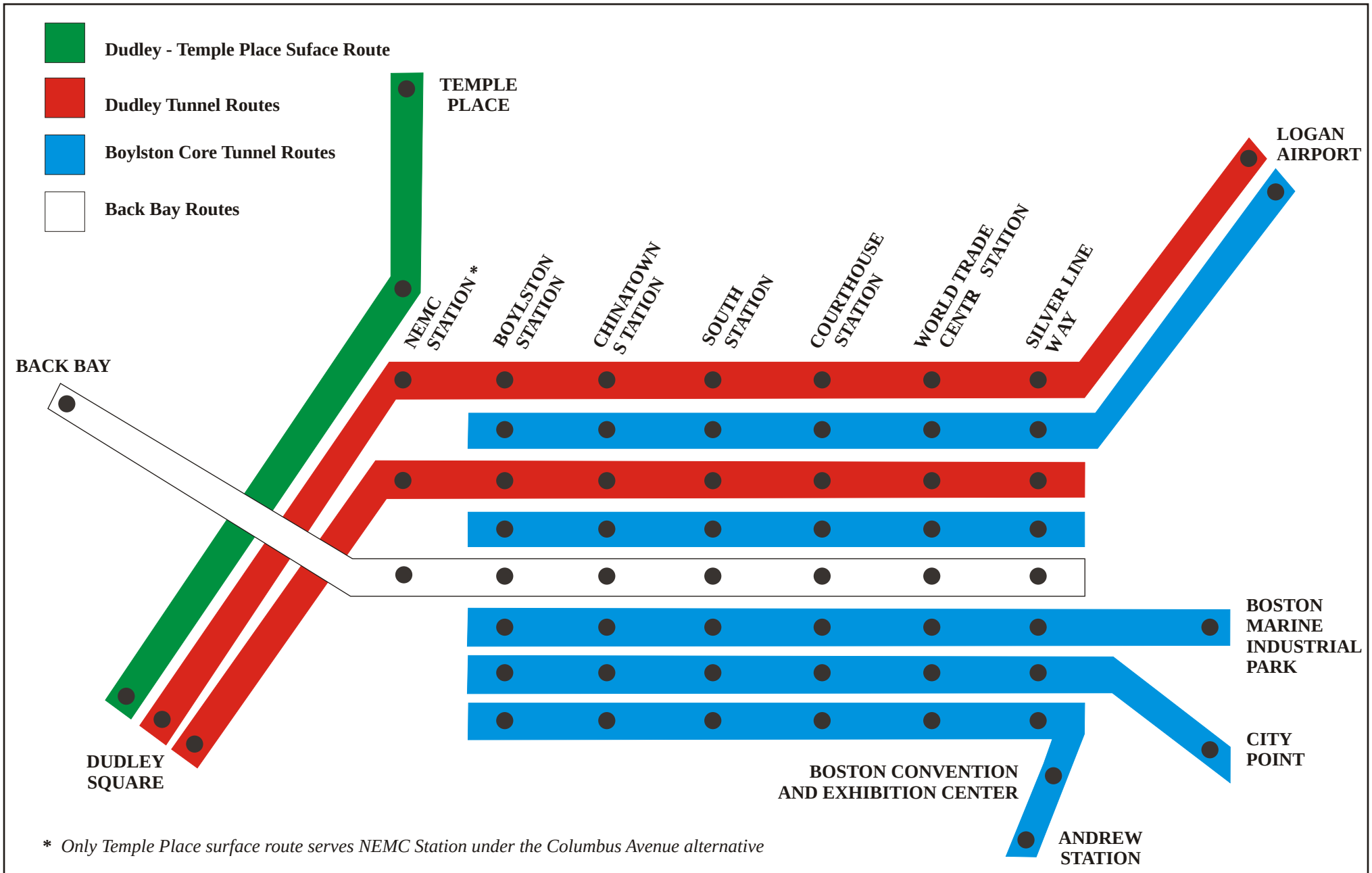
The Charles, Tremont and Stuart Street tunnel alignments would all surface at a portal located between the NEMC garage and the Doubletree Hotel. A stop would be provided within the Silver Line ROW at NEMC. (See Figure 3.4-7.)

NEMC Portal Dudley Route

On the Outbound Dudley Route, Silver Line vehicles coming out of the portal would turn right onto Washington Street and continue south along the route of the existing Phase I service on Washington Street to Dudley Station. The Inbound Route also follows Washington Street to the portal. The Dudley to Downtown Crossing route operating on six-minute headways will remain on the surface, following the same route as the existing Phase I service. (See Figure 3.5-2.)

NEMC Portal Back Bay Route

On the Outbound Back Bay Route, Silver Line vehicles coming out of the portal would turn right on Washington Street, right on Oak Street and right on Charles Street South, continuing north to Park Plaza. The vehicles would then turn left at Park Plaza and continue on St. James Avenue, bearing left on Huntington to a right on Belvedere Street, and then a right on Dalton Street to a layover stop. The Inbound Back Bay Route would proceed north on Dalton Street, right on Boylston Street, and right on Clarendon Street to Stuart Street. From there the vehicle would proceed east on Stuart Street to Arlington Street and Herald Street, turning left on Washington Street and returning to the portal. (See Figure 3.5-2 for the routes and location of proposed surface stops.)



* *Only Temple Place surface route serves NEMC Station under the Columbus Avenue alternative*

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Figure 3.5-1
Build Alternatives Operating Plan

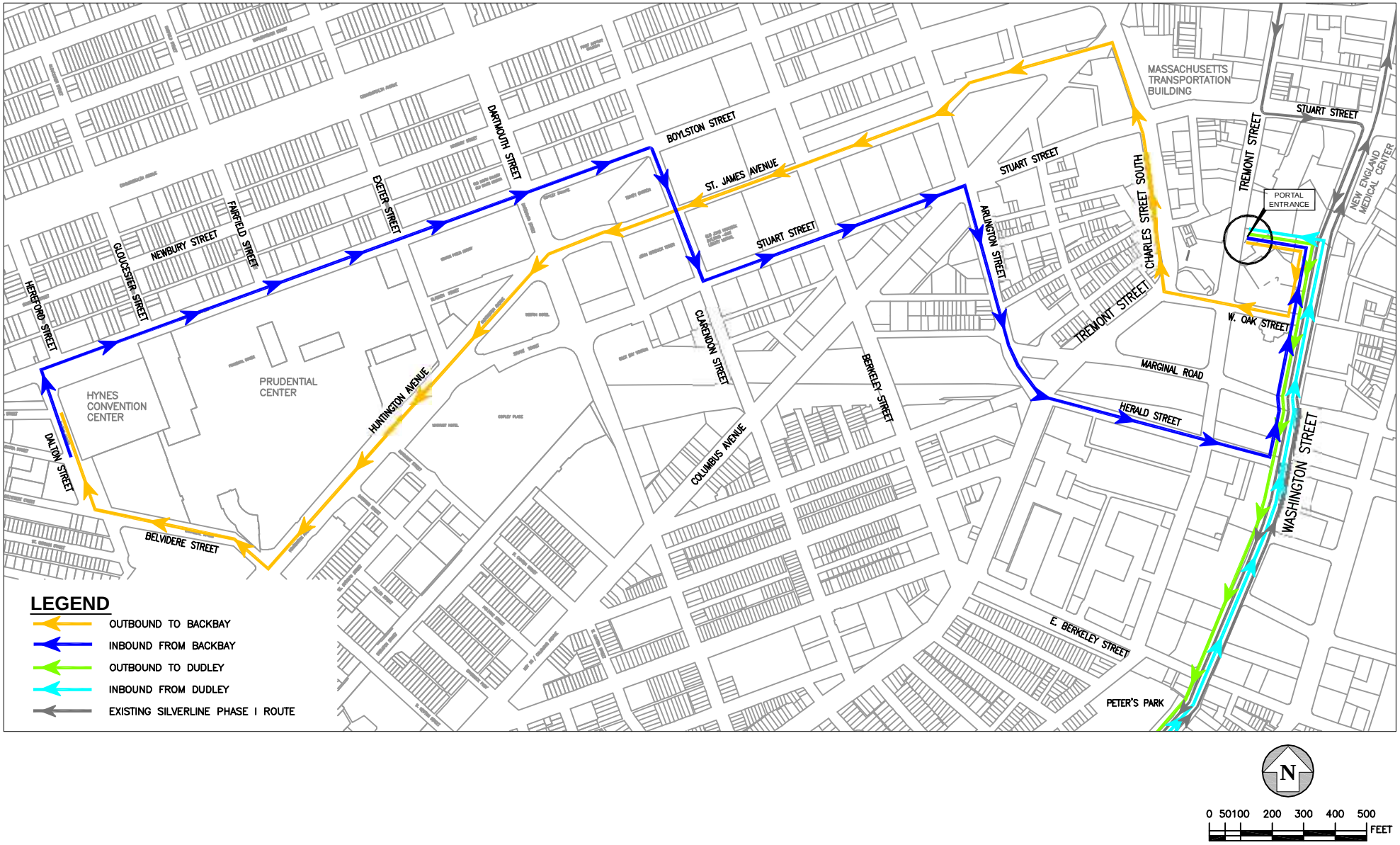

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Figure 3.5-2
NEMC Portal, Dudley and Back Bay Routes

3.5.2.2 Columbus Avenue Portal Surface Routes

The Columbus Avenue tunnel alignment surfaces at a portal located west of Arlington Street with an outbound surface stop located near Berkeley Street adjacent to the Salvation Army Headquarters building. The inbound bus stops would be located on Berkeley Street south of Columbus for Dudley service and on Columbus Avenue west of Berkeley Street for Back Bay service. (See previous Figure 3.4-11.)

Columbus Avenue Portal Dudley Route

On the Outbound Dudley Route, a Silver Line vehicle leaving the Columbus Avenue portal would turn right onto Berkeley Street, then follow Stuart, Arlington, and Herald Streets to reach Washington Street. From there the route would continue south along the route of the existing Phase I service on Washington Street to Dudley Station. (See Figure 3.5-3.) Improvements to the Herald/Washington Street intersection would be made to facilitate right turns onto Washington Street. The existing Herald Street outbound Silver Line stop would also need to be modified (see Figure 3.5-4).

The Inbound Dudley Route would follow Washington Street, turn left on East Berkeley Street, and then follow Berkeley Street, turning right on Columbus Avenue to enter the portal.

As the route map shows, inbound vehicles entering the Columbus Avenue portal would not serve the Herald and the NEMC stops on Washington Street but they would instead provide a one-seat ride from Dudley to the Back Bay/Columbus/Berkeley area, which is not provided with the NEMC portal. This route would also require that the existing inbound East Berkeley Street stop on Washington Street be shifted to a mid-block location on the near side of the East Berkeley/Washington Street intersection.

The Dudley to Downtown Crossing route will remain on the surface, operating on six-minute headways, and following the same route as the existing Phase I service with inbound and outbound stops at NEMC.

Note that alternative outbound routing options involving changes in the local street system (e.g., a Berkeley Street contraflow lane to Chandler Street, and/or an exclusive Herald Street bus lane) may provide shorter outbound travel times between the Columbus Avenue portal and the Washington Street corridor. As described above, the MBTA has identified a route that is a viable and operationally sufficient route, given the current roadway network. It is, however, a somewhat circuitous route and there are opportunities to make it a more direct route consistent with Bus Rapid Transit standards. These opportunities, such as adding contraflow lanes, changing street patterns, etc. require significant coordination with the Boston Transportation Department and the neighborhoods. The MBTA will continue to develop these types of options to determine if any are viable, and keep the FTA, EOEA, the City and the public informed of progress. This SDEIS/EIR is predicated, however, on the routes described above. Any improvements to these routes would have an improvement to ridership and user benefit, but for the purpose of the environmental review, these ridership results would be comparable. These options would be further investigated and described in the final environmental documentation should Columbus Avenue be selected as the Preferred Alternative.

Columbus Avenue Portal Back Bay Route

Silver Line vehicles on this proposed Outbound Back Bay route would turn right on Berkeley Street after the portal stop. The vehicle would then turn left on St. James Avenue and follow the same route as the NEMC portal route to the Dalton Street layover. The Inbound Back Bay route would also follow the corresponding NEMC route as far as Clarendon Street, where the vehicle would turn right and travel south on Clarendon Street to Columbus Avenue, stopping on Columbus Avenue west of Berkeley Street before entering the Columbus Avenue portal.

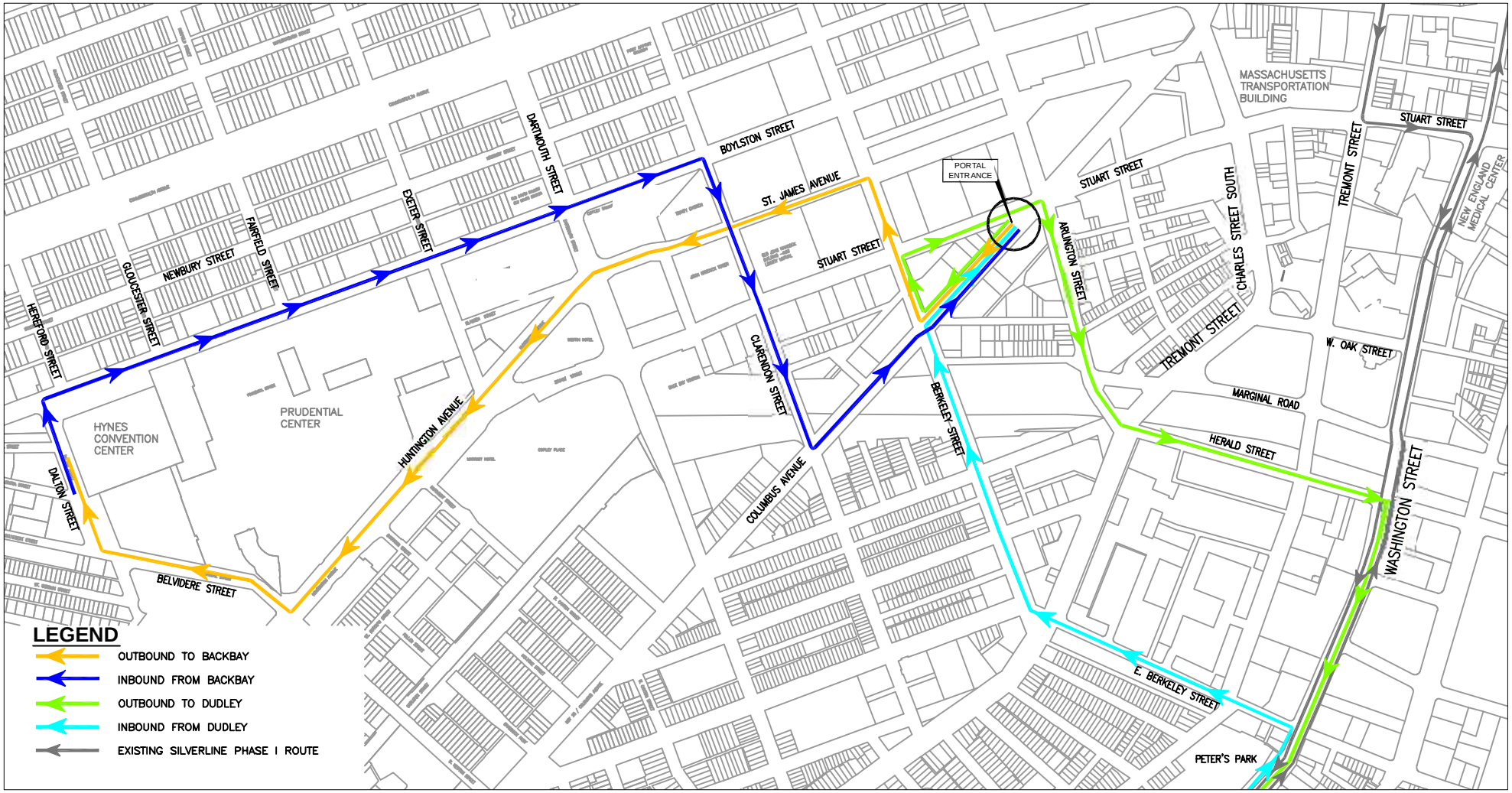

Figure 3.5-3
Columbus Avenue Portal, Dudley and Back Bay Routes

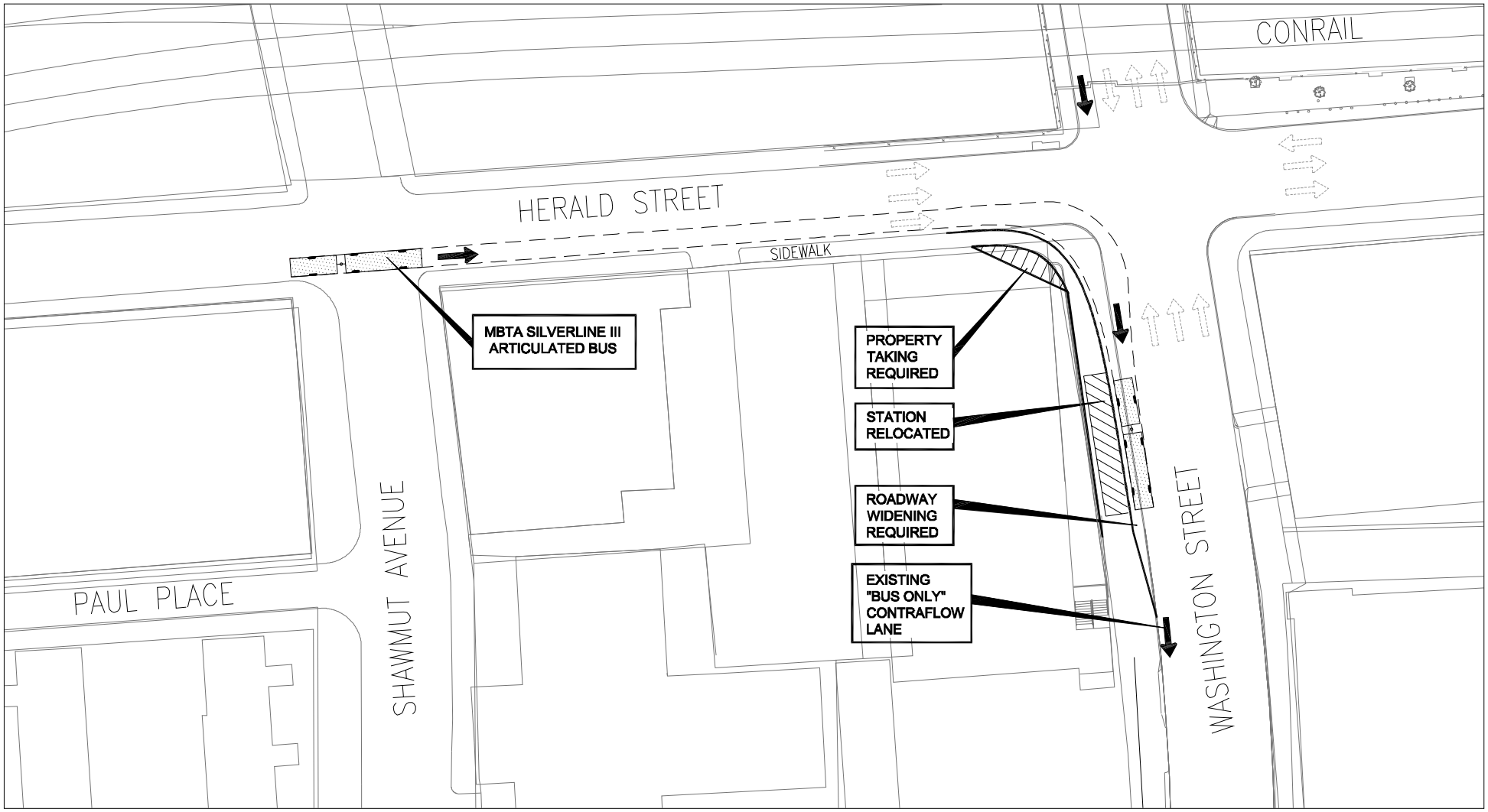

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Figure 3.5-4
Columbus Avenue Alternative
Herald Street Improvements

Note that while the Back Bay routes for the Columbus Avenue portal are considerably shorter than the corresponding NEMC portal routes, they utilize the same surface stop locations for the on-street portion of the route. (See Figure 3.5-3 for the routes and location of proposed surface stops.)

3.5.3 Silver Line Vehicle Fleet Requirements

3.5.3.1 Silver Line Vehicle

For Phase I of the Silver Line system in operation since July 2002, 60-foot articulated compressed natural gas (CNG) vehicles currently provide service between Dudley Square Station and Downtown Crossing/Temple Place. For Phase II, which initiated revenue service to BMIP and City Point in December 2004**,** 60-foot articulated dual mode vehicles are in operation (see Figure 3.5-5). Once all Phase II routes are in service, the vehicles will operate in electric mode via catenary in the Silver Line tunnel between South Station and the World Trade Center, and in low-emitting diesel-powered GenSet mode using ultra-low diesel fuel on surface routes from the portal at D Street to BMIP, City Point, BCEC/Andrew Station, and Logan Airport via the Ted Williams Tunnel.

For the Silver Line Phase III Build Alternatives, the majority of the service would be provided by the dual mode vehicles, which would operate in electric mode on catenary in the tunnel, changing to diesel mode on surface routes from the portal to Dudley and Back Bay. However, the Dudley to Downtown Crossing service would continue to use the 60-foot articulated CNG vehicles, as this route operates entirely on the surface with no overhead catenary.

3.5.3.2 Fleet Requirements

The Baseline Alternative fleet requirements reflect the need for additional vehicles to support an increased frequency of service. The service plan for the Build Alternatives reflects the proposed operating plan discussed in Section 3.5.2, with minor variations due to the travel times of the surface routes associated with each portal. Table 3.5-1 provides a summary of the vehicle requirements for each of the alternatives. Note that these vehicle requirements represent total fleet needs for the full Silver Line, and the MBTA fleet already includes vehicles for Phases I and II now in operation. The total number of new vehicles that will need to be procured once Phase III is implemented is 45 for the Charles Street Alternative and 46 for the Tremont Street, Stuart Street, and Columbus Avenue Alternatives. The dual-mode vehicles will be stored primarily at the MBTA's Southampton Street Maintenance Facility. Maintenance of the CNG buses is expected to shift to the Arborway Facility.

Table 3.5–1 Fleet Requirements by Alternative

	Dual Mode Vehicles	CNG Vehicles	Dual Mode Vehicles Spares	CNG Vehicles Spares	Total Fleet Requirement
Baseline Alternative					84
NEMC Portal Alternatives					
Charles Street	69	8	15	2	94
Tremont Street	70	8	15	2	95
Stuart Street	70	8	15	2	95
Columbus Avenue Portal Alternative					
Columbus Avenue	70	8	15	2	95

Source: IBI, March 8, 2005

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Figure 3.5-5
Silver Line
Dual Mode Vehicle

3.6 Ridership

Ridership is a key measure of the success of the Phase III alternatives in meeting the project purpose and need through their ability to attract transit riders through improved service, fewer transfers, and reduced travel time.

The ridership forecasts for the Phase III alternatives have been prepared by the Central Transportation Planning Staff (CTPS) using their regional travel demand model set for eastern Massachusetts. This model set meets FTA requirements for forecasting ridership of major transit capital investment projects, like the Silver Line. Forecasts have been developed for the year 2025; they account for changes in land uses and associated trip-making, as well as anticipated improvements to the region's transportation network, independent of the Phase III project, over the next 20 years.

To ensure comparability of results, forecasts for the four Build Alternatives examined in this SDEIS/EIR assume the same operating plans in terms of the routes to be operated and their headways (see Section 3.5.2). From an operational perspective, the only difference among the alternatives is the portal location at which the Silver Line vehicles will enter and exit the Phase III tunnel in downtown Boston. The Tremont Street, Stuart Street, and Charles Street Alternatives, each with a portal at NEMC, have roughly the same route trip times (the tunnels are generally the same in length), so separate ridership forecasting is not needed for these three alternatives. However, the location of the portal in the Columbus Avenue Alternative necessitates changes in surface routings, compared to the three NEMC portal alternatives. Therefore, separate ridership forecasts have been prepared for the Columbus Avenue Alternative.

Table 3.6-1 summarizes the 2025 forecast boardings for the No-Build, Baseline, and the four Build alternatives (again, the Tremont, Charles and Stuart Street Alternatives have identical results). As shown, implementation of a tunnel connection between Phases I and II of the Silver Line will have a significant impact on transit ridership, with weekday Silver Line boardings increasing by between approximately 165 percent and 176 percent as compared to the No-Build Alternative.

Table 3.6-1 Silver Line Boardings by Alternative, 2025

Silver Line Boardings	Alternatives			
	No-Build[1]	Baseline[2]	Tremont, Charles and Stuart/ NEMC Portal[3]	Columbus Avenue[4]
Average Weekday	58,000	62,517	160,228	153,940
Annual	17,110,000	18,442,515	47,267,260	45,412,300

Source: CTPS

Notes:

1. Model run date 4/24/05 – System Wide Ridership.
2. Model run date 3/31/05 – System Wide Ridership.
3. Model run date 3/4/05 – System Wide Ridership.
4. Model run date 2/4/05 – System Wide Ridership.

Table 3.6-2 provides additional detail by Silver Line route for the Build Alternatives. Boardings are totaled in each direction for each of the eight proposed Silver Line routes (i.e., total daily boardings are shown for trips on the route that begins at BMIP and ends at Boylston, as well as in the opposite direction, from Boylston to BMIP).

Table 3.6-3 provides the peak hour mode share for trips originating in the Washington Street Corridor and Dalton Street area destined for four key activity centers served by the Silver Line: Financial Center, South Station, Waterfront, and Logan Airport.

Table 3.6-2 – Silver Line Daily Boardings by Route, 2025

Route	Daily Boardings	
	Tremont, Charles and Stuart Alternatives/ NEMC Portal[1]	**Columbus Avenue Alternative[2]**
BMIP-Boylston	4,009	3,886
Boylston-BMIP	6,275	6,031
Boylston – City Point	7,426	7,142
City Point - Boylston	5,784	5,580
Boylston-Silver Line Way	13,926	13,373
Silver Line Way-Boylston	14,440	13,883
Boylston-Logan	9,841	9,464
Logan-Boylston	9,608	9,258
Boylston – Andrew/BCEC	10,172	9,780
Andrew/BCEC – Boylston	9,907	9,540
Silver Line Way-Dalton	4,970	7,197
Dalton-Silver Line Way	5,081	7,189
Silver Line Way-Dudley	10,690	9,483
Dudley-Silver Line Way	9,982	8,749
Downtown Crossing-Dudley	6,756	5,918
Dudley-Downtown Crossing	6,396	5,538
Dudley-Logan	12,466	10,888
Logan-Dudley	12,488	11,043
Total Daily Boardings[3]	**160,228**	**153,940**

Source: CTPS
Notes:
1. Model run date 3/4/05.
2. Model run date 2/4/05.
3. Numbers will not add due to rounding.

Table 3.6-3 – Peak Hour Mode Share

2025 Mode Share		Baseline[1]	NEMC Portal[2]	Columbus Ave Portal[3]
System Wide				
	Person Trips	16,185,200	16,185,200	16,185,200
	Linked Transit Trips	1,161,900	1,176,100	1,173,452
	Transit Mode Share	7.18%	7.27%	7.25%
AM peak period Homebound/ Work trips by area				
Washington Street Corridor to Financial Area				
	Person Trips	1053	1053	1053
	Transit Trips	793	940	933
	Transit Mode Share	75.3%	89.3%	88.6%
Washington Street Corridor to South Station Area				
	Person Trips	370	370	370
	Transit Trips	182	287	267
	Transit Mode Share	49.2%	77.6%	72.2%
Washington Street Corridor to Seaport Area				
	Person Trips	516	516	516
	Transit Trips	379	425	424
	Transit Mode Share	73.4%	82.4%	82.2%
Washington Street Corridor to Logan				
	Person Trips	143	143	143
	Transit Trips	84	90	85
	Transit Mode Share	58.7%	62.9%	59.4%
Back Bay Corridor to Financial Area				
	Person Trips	1,429	1,429	1,429
	Transit Trips	1,186	1,233	1,236
	Transit Mode Share	83.0%	86.28%	86.49%
Back Bay Corridor to South Station Area				
	Person Trips	384	384	384
	Transit Trips	309	354	338
	Transit Mode Share	80.47%	92.19%	88.02%
Back Bay Corridor to Seaport Area				
	Person Trips	581	581	581
	Transit Trips	504	547	507
	Transit Mode Share	86.75%	94.15%	87.26%
Back Bay Corridor to Logan				
	Person Trips	330	330	330
	Transit Trips	286	286	286
	Transit Mode Share	86.67%	86.67%	86.67%
Back Bay Corridor to South Boston				
	Person Trips	111	111	111
	Transit Trips	90	90	90
	Transit Mode Share	81.08%	81.08%	81.08%

Source: CTPS

Note: Person trips refer to all trips made, regardless of mode, by a person from their origin to their destination. A subset of person trips, linked transit trips refer to those trips that involve at least some travel on transit between a person's origin and destination.

Notes:

1. Model run date - 2/4/05
2. Model run date - 3/4/05.
3. Model run date - 2/8/05.

The results presented in these tables indicate the ability of the Build Alternatives to attract riders to the Silver Line. Further demonstration of the ability of the Build Alternatives to improve mobility is provided in Tables 3.6-4 and 3.6-5. This table shows the total travel time savings and reduction in transfers as a result of the Phase III Build Alternatives for several key pairs of origins and destinations in the Boston area. Trips between these origin-destination pairs account for approximately two-thirds of all Silver Line trips in 2025. The travel time savings are the result of fewer transfers, reduced in-vehicle travel time, and lessened wait and walk time that are enabled once the Phase III tunnel connects Silver Line Phases I and II.

Table 3.6-4 – New England Medical Center Portal Alternatives - Travel Time Savings for Key Markets in 2025[1]

	DESTINATION (Transit Market)	Financial District	South Station	Theater District/ Chinatown	Seaport/ Waterfront	Back Bay (Green)
ORIGIN (Transit Market)						
Back Bay (Green Line: Arlington to Kenmore)	Travel time savings	5.4 minutes	6.9 minutes	6.6 minutes	8.1 minutes	0 minutes
	Reduction in transfers	No change	1	No change	1	No change
Green Line (West of Kenmore: All Surface Routes)	Travel time savings	6.6 minutes	6.2 minutes	0 minutes	6.8 minutes	0 minutes
	Reduction in transfers	No change	1	No change	1	No change
Silver Line Phase 1 (Dudley to Kneeland Street)	Travel time savings	9.4 minutes	9.1 minutes	2.3 minutes	9.9 minutes	1.1 minutes
	Reduction in transfers	1	1	No change	1	No change
Theater District (Boylston and Chinatown)	Travel time savings	6.5 minutes	6.6 minutes	5.6 minutes 2	8.8 minutes	2.6 minutes
	Reduction in transfers	1	1	No change	1	No change
Financial District (Downtown Crossing)	Travel time savings	2.2 minutes	2.6 minutes	3.6 minutes	3.7 minutes	1.9 minutes
	Reduction in transfers	No change	No change	No change	No change	No change
Inner North Shore (Blue Line North to Revere)	Travel time savings	2.2 minutes	2.4 minutes	0 minutes	0 minutes	0 minutes
	Reduction in transfers	No change	No change	No change	No change	No change
South Station (Red Line/ Commuter Rail)	Travel time savings	0 minutes	0 minutes	6.2 minutes	0 minutes	4.4 minutes
	Reduction in transfers	No change	No change	1	No change	No change
Hyde Park / Jamaica Plain / Roxbury	Travel time savings	2.2 minute	2.4 minutes	3.1 minute	7.8 minutes	3.2 minutes
	Reduction in transfers	No change	No change	No change	1	No change

Source: CTPS Regional Model – 2025. CTPS data dated 3/16/05.
Notes:
1. Silver Line Phase III Build versus Baseline. Key markets reflect 67.8% of OD Pairs analyzed.
2. Travel time savings for this origin-destination pair reflects in large part trips previously made on foot now being made via the Silver Line.

Table 3.6-5 – Columbus Portal Alternative - Travel Time Savings for Key Markets in 2025[1]

	DESTINATION (Transit Market)	Financial District	South Station	Theater District/ Chinatown	Seaport/ Waterfront	Back Bay (Green)
ORIGIN (Transit Market)						
Back Bay (Green Line: Arlington to Kenmore)	Travel time savings	7.9 minutes	8.4 minutes	8.2 minutes	10.6 minutes	0 minutes
	Reduction in transfers	1	1	1	1	No change
Green Line (West of Kenmore: All Surface Routes)	Travel time savings	8.0 minutes	8.1 minutes	0 minutes	10.3 minutes	0 minutes
	Reduction in transfers	1	1	No change	1	No change
Silver Line Phase 1 (Dudley to Kneeland Street)	Travel time savings	6.4 minutes	6.0 minutes	0 minutes	7.7 minutes	3.3 minutes
	Reduction in transfers	1	1	No change	1	No change
Theater District (Boylston and Chinatown)	Travel time savings	6.2 minutes	6.3 minutes	5.4 minutes	8.6 minutes	5.7 minutes
	Reduction in transfers	1	1	No change	1	No change
Financial District (Downtown Crossing)	Travel time savings	2.2 minutes	2.6 minutes	3.6 minutes	3.7 minutes	3.1 minutes
	Reduction in transfers	No change	No change	No change	No change	No change
Inner North Shore (Blue Line North to Revere)	Travel time savings	1.6 minutes	2.0 minutes	0 minutes	0 minutes	0 minutes
	Reduction in transfers	No change	No change	No change	No change	No change
South Station (Red Line/ Commuter Rail)	Travel time savings	0 minutes	0 minutes	6.2 minutes	0 minutes	5.9 minutes
	Reduction in transfers	No change	No change	1	No change	No change
Hyde Park / Jamaica Plain / Roxbury	Travel time savings	0.9 minute	1.4 minutes	2.0 minutes	4.9 minutes	3.4 minutes
	Reduction in transfers	No change	1	No change	1	No change

Source: CTPS Regional Model – 2025. CTPS data dated 3/16/05.
Note:
1. Silver Line Phase III Build versus Baseline. Key markets reflect 62.0% of OD Pairs analyzed.

Many of the largest travel time savings accrue to some of the most transit-dependent communities in Boston, including residents of Dudley Square and Chinatown. (See Section 4.2.7.) For these two communities, respectively, travel time to the rapidly developing Waterfront area will be reduced by nine to 10 minutes per trip on average for the NEMC portal alternatives and eight to nine minutes per trip for the Columbus Portal Alternative. Also notable are the improved travel time benefits for trips originating in the Back Bay and destined to the Central Business Districts (CBD) and Waterfront area, averaging eight to over 10 minutes savings per trip.

The Phase III Build Alternatives will allow better and more convenient access and faster trip times to and from key origins and destinations within the Boston area and inner suburbs. By

connecting Phases I and II, the Phase III Build Alternatives provide important connections among existing transit lines, creating an interconnected rapid transit system needed to serve growing trip-making demand among key markets.

3.7 Capital and Operating Costs

This section summarizes the estimated capital and operating costs for the alternatives under consideration.

3.7.1 Capital Costs

Capital costs include the cost of infrastructure, such as the tunnels and stations, as well as the costs of acquiring ROW, and of purchasing additional vehicles. Capital costs are expressed in Year-of Expenditure (YOE) dollars and are summarized in Table 3.7-1.

Table 3.7-1 – Summary of Capital Costs

	Tremont Street	Charles Street	Stuart Street	Columbus Avenue
Construction	$588.5 million	$559.0 million	$592.9 million	$558.4 million
Soft Costs	$140.9 million	$130.8 million	$140.4 million	$131.0 million
Right-of-Way	$16.2 million	$ 15.7 million	$ 15.7 million	$ 17.5 million
Vehicles	$62.7 million	$ 62.7 million	$ 62.7 million	$ 64.3 million
TOTAL	**$808.3 million**	**$768.2 million**	**$811.7 million**	**$771.2 million**

3.7.2 Operating Costs

Operating costs include the annual cost to operate and maintain the Silver Line service and are presented in Table 3.7-2 as an incremental cost to the Baseline Alternative service in 2005 dollars.

Table 3.7-2 – Summary of Operating Costs

	Tremont Street	Charles Street	Stuart Street	Columbus Avenue
Annual Operating and Maintenance Costs	$5.2 million	$5.2 million	$5.2 million	$5.1 million

3.8 Schedule

The MBTA had previously anticipated that Phase III of the Silver Line would be substantially complete and open for revenue service by the end of 2010. This schedule was predicated on the availability of federal funding for the project. However, due to the MBTA's commitment to conduct a comprehensive analysis of Phase III alternatives, the schedule for implementation of Phase III has been revised. It is estimated that construction of the preferred alternative selected for Phase III of the Silver Line will extend for a period of between four and six years. Preliminary construction activities are anticipated beginning in 2008, with opening of revenue service on Phase III of the Silver Line in 2013.

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CHAPTER 4.0 Affected Environment

4.1 Introduction

This chapter presents the baseline conditions that represent the No-Build environment for the Silver Line Phase III Project. These conditions form the basis against which benefits and impacts from the project alternatives are compared and evaluated in Chapter 5. For those categories that evaluate operational impacts, such as traffic and air quality, the No-Build is compared to the Build Alternatives for 2013, the year that Phase III of the Silver Line is planned to be operational.

Eleven potential impact categories are analyzed: socioeconomics and land use; environmental justice; traffic and parking; transit, pedestrian and bicycle facilities; air quality; noise and vibration; geology and groundwater; natural resources; cultural resources; parklands; and aesthetics. Construction related impacts, including hazardous materials, are discussed in Chapter 6.

For most categories, existing resources are described along the Core Tunnel Segment, then along each of the four alignment alternatives – Charles, Tremont, Stuart and Columbus. Because some categories, traffic for example, would only affect the area around the proposed portals, existing conditions are described around the two portal areas: New England Medical Center (NEMC), for the Charles, Tremont and Stuart Street Alternatives; and Columbus Avenue, for the Columbus Avenue Alternative.

4.2 Socioeconomics and Land Use

This section describes socioeconomic and land use conditions for Phase III of the Silver Line. The Phase III area is generally separated from the Phase I and II areas by the Massachusetts Turnpike (I-90) and the Fort Point Channel, respectively.

In the sections below, corridor population, households and employment are described first, followed by an inventory of land uses along the Phase III corridor and a discussion of zoning within the three downtown districts through which Phase III traverses.

Tables 4.2-1 through 4.2-3 summarize the socioeconomic characteristics for the Silver Line Phase III alignment alternatives, for the City of Boston and the metropolitan region. Socioeconomic characteristics both along the Silver Line Phase III alignment alternatives and within the Full Build Silver Line corridor describe the area encompassed within a half-mile radius of the Silver Line stations. The tables include socioeconomic data on population and households from the year 2000 U.S. Census, and 2000 employment and 2025 socioeconomic projections developed by the Metropolitan Area Planning Council (MAPC).

Generally speaking, these data show that in addition to high population and employment along both corridors today, the rate of growth of both jobs and residents in the co1rridor served by Silver Line Phase III is higher than that for the City of Boston and the Metropolitan area. In addition, it shows that existing (2000) and projected (2025) population and employment within the Columbus Avenue Alternative corridor is higher than for the Charles, Tremont and Stuart Street Alternatives.

Table 4.2-1 – Socioeconomic Characteristics for the Silver Line Phase III Alternatives, Full Build Silver Line Corridor and the Boston Metropolitan Region - Population

	2000 Population[1]	2025 Population[2]	25-year Increase	Annual Compound Growth
Silver Line Phase III – Tremont / Charles / Stuart Street Alternatives	20,851	31,558	51.4%	1.7%
Full Build Silver Line - Tremont / Charles / Stuart Street Alternatives	57,630	79,882	38.6%	1.3%
Silver Line Phase III – Columbus Avenue Alternative	29,899	41,823	39.9%	1.3%
Full Build Silver Line – Columbus Avenue Alternative	62,159	85,248	37.1%	1.3%
City of Boston[2]	589,141	637,213	8.1%	0.3%
Boston MPO Region[2]	3,066,200	3,192,049	4.1%	0.2%

Sources: 1. U.S. 2000 Census; Central Transportation Planning Staff (CTPS);
2. Metropolitan Area Planning Council (MAPC)

Population

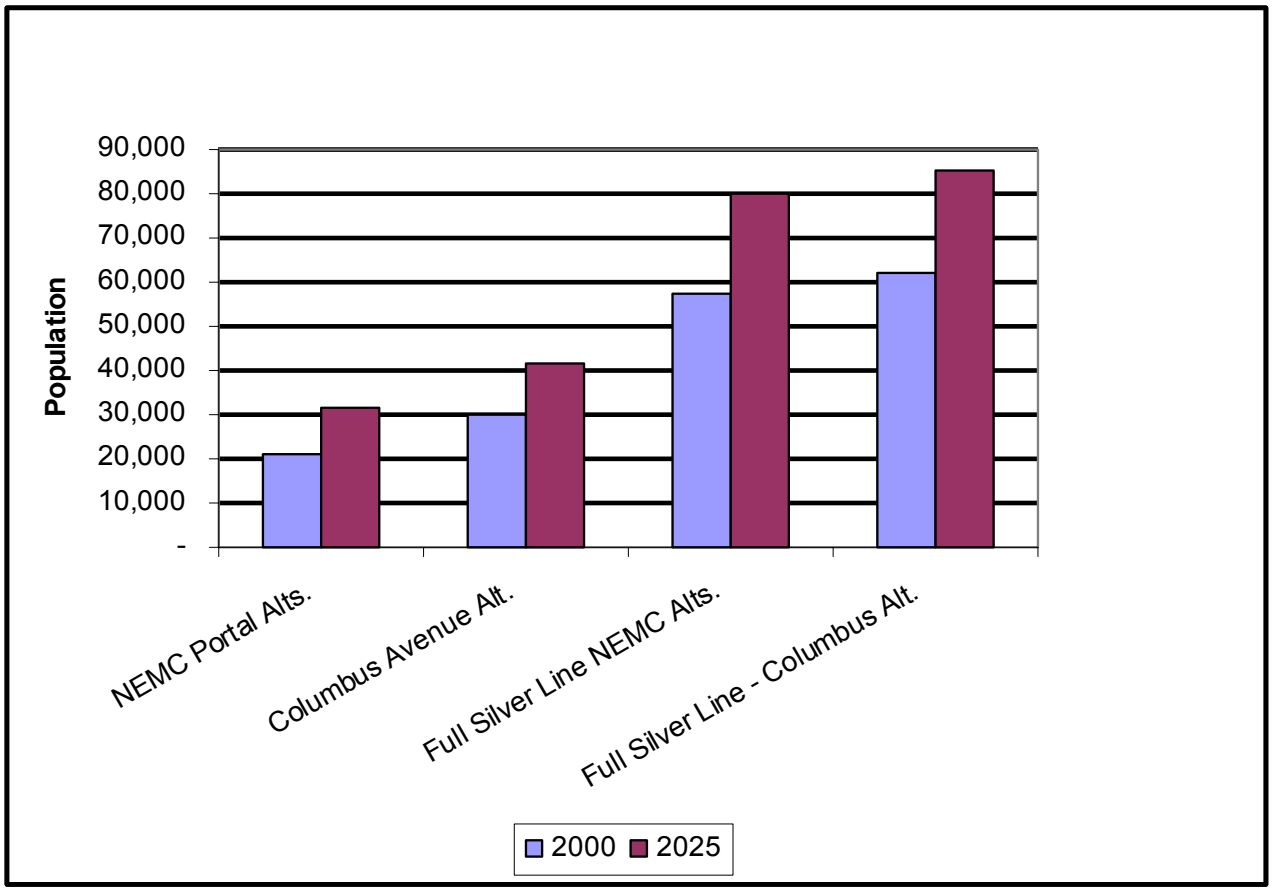


Table 4.2-2 – Socioeconomic Characteristics for the Silver Line Phase III Alternatives, Full Build Silver Line Corridor and the Boston Metropolitan Region - Households

	2000 Households[1]	2025 Households[2]	25-year Increase	Annual Compound Growth
Silver Line Phase III – Tremont / Charles / Stuart Street Alternatives	10,536	15,735	49.3%	1.6%
Full Build Silver Line - Tremont / Charles / Stuart Street Alternatives	28,078	39,698	41.4%	1.4%
Silver Line Phase III – Columbus Avenue Alternative	15,796	21,944	38.9%	1.3%
Full Build Silver Line – Columbus Avenue Alternative	30,928	43,141	39.5%	1.3%
City of Boston[2]	239,528	276,978	15.6%	0.6%
Boston MPO Region[2]	1,277,500	1,333,817	4.4%	0.2%

Sources: 1. U.S. 2000 Census; Central Transportation Planning Staff (CTPS);
2. Metropolitan Area Planning Council (MAPC)

Households

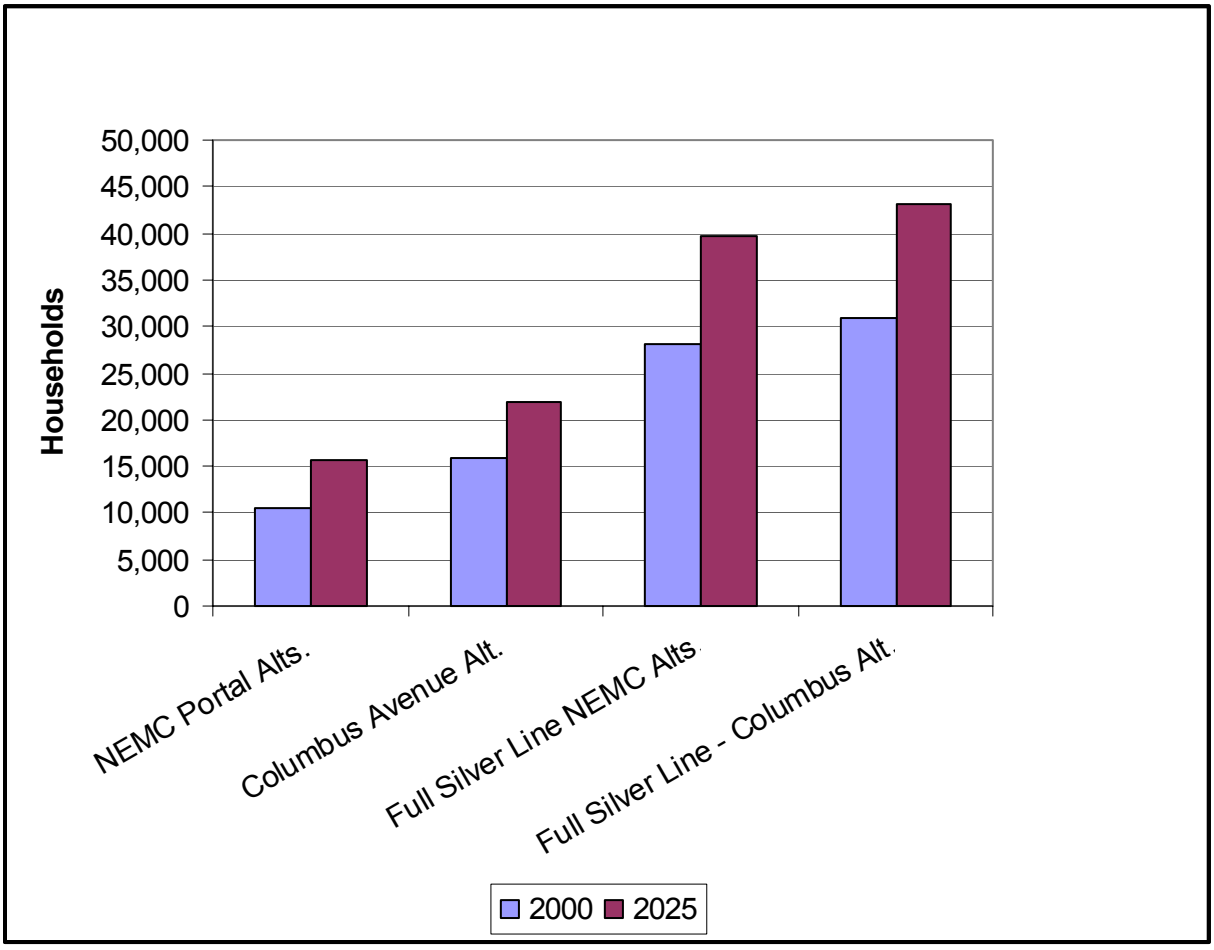
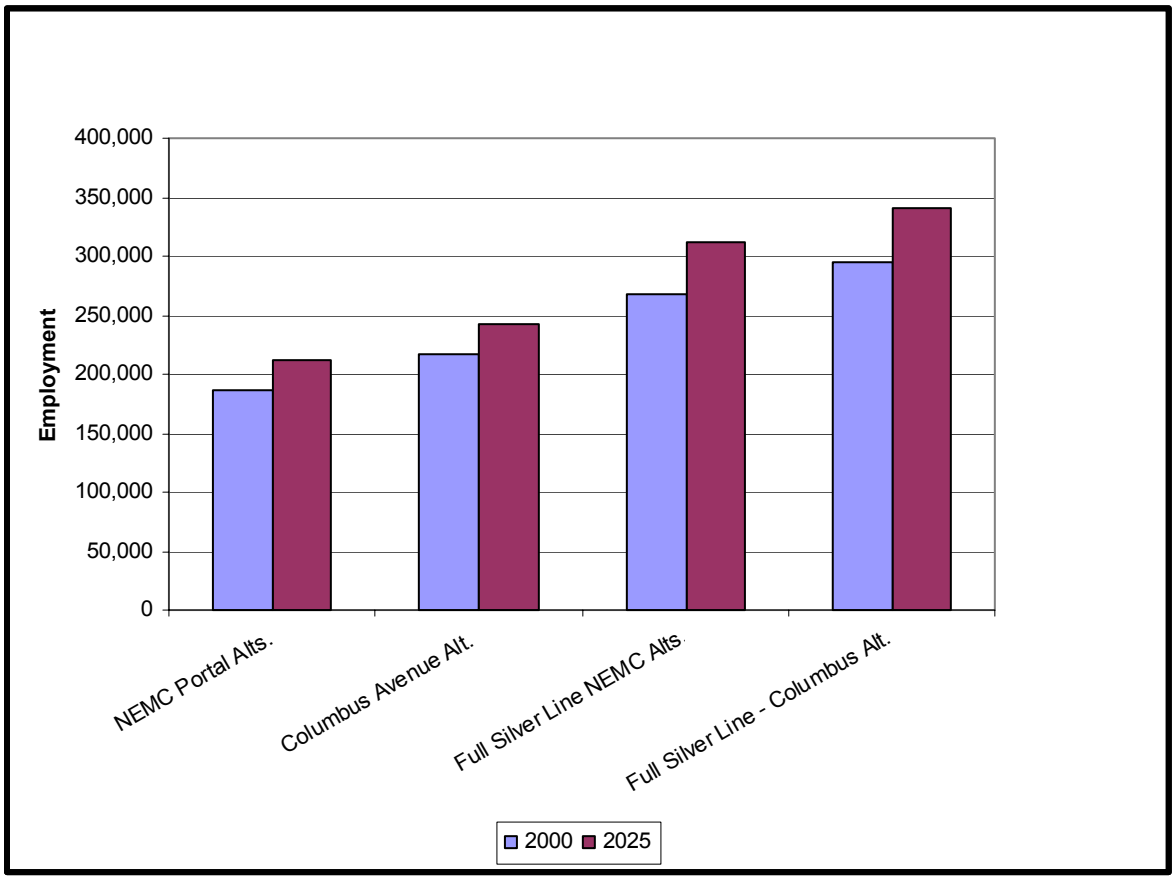


Table 4.2-3 – Socioeconomic Characteristics for the Silver Line Phase III Alternatives, Full Build Silver Line Corridor and the Boston Metropolitan Region - Employment

	2000 Employment[1]	2025 Employment[2]	25-year Increase	Annual Compound Growth
Silver Line Phase III – Tremont / Charles / Stuart Street Alternatives	187,154	212,190	13.4%	0.5%
Full Build Silver Line - Tremont / Charles / Stuart Street Alternatives	267,123	312,115	16.8%	0.6%
Silver Line Phase III – Columbus Avenue Alternative	217,200	242,467	11.6%	0.4%
Full Build Silver Line – Columbus Avenue Alternative	295,699	341,001	15.3%	0.6%
City of Boston *(2001)*[2]	578,485	602,124	4.1%	0.2%
Boston MPO Region *(2001)*[2]	1,872,821	2,109,334	12.6%	0.5%

Sources: 1. U.S. 2000 Census; Central Transportation Planning Staff (CTPS);
2. Metropolitan Area Planning Council (MAPC)

Employment



4.2.1 Population

According to the 2000 Census, the population living within a half-mile distance ("catchment areas") of the Tremont Street/Charles/Stuart Street Alternatives is 20,851. The Columbus Avenue Alternative encompasses an existing population of 29,899. Chinatown and Midtown neighborhoods are directly served by Silver Line Phase III stations. Other City of Boston neighborhoods in the vicinity of Silver Line Phase III stations include Back Bay, Beacon Hill, the South End, and Bay Village.

By 2025, population is expected to increase to 31,558 (51 percent) and 41,823 (40 percent) within the NEMC Portal and Columbus Avenue Portal catchment areas, respectively (See Table 4.2-1). Population growth for both catchment areas is significantly higher than the population growth projected for the City of Boston (8.1 percent) and the Boston MPO region (4.1 percent) over the same period.

4.2.2 Households

The number of households residing within the Tremont Street/Charles/Stuart Street Alternatives catchment area is estimated at 10,536, and is projected to increase to 15,735 by 2025, a growth rate of 49.3 percent. The Columbus Avenue Alternative catchment area is comprised of 15,796 households, which is forecast to increase by 39 percent to 21,944 households by 2025.

4.2.2.1 Transit Dependent Households

A transit-dependent household is one with no private vehicle ownership. About 47 percent of the households within the Tremont/Charles/Stuart Alternatives catchment area are transit dependent, compared to 43 percent of the households within the Columbus Avenue Alternative catchment area. The percentage of transit-dependent households served by the Phase III and the Full Build Silver Line are significantly higher than the percentage of transit-dependent households in the region as a whole. Transit-dependent households in the City of Boston and the Boston metropolitan area account for 34.9 and 14.5 percent, respectively, of total households.

Figures 4.2-1 and 4.2-2 show transit-dependent households in proximity to Silver Line Phase III stations. In addition to several downtown Boston households that choose not to own a vehicle due to transit accessibility and parking limitations, transit-dependent communities include Chinatown, South End, and Roxbury.

4.2.3 Employment

According to MAPC employment statistics, year 2000 employment within a half-mile distance of Phase III stations served by the Tremont Street/Charles/Stuart Street Alternatives is 187,154, whereas employment within a half-mile of the Columbus Avenue Alternative is 217,200.

By 2025, employment within the Phase III catchment area is estimated to grow between 11.6 and 13.4 percent for the Silver Line Phase III alternatives. Employment growth in these areas is projected to increase at a higher rate than employment within the City of Boston as a whole, but at a similar rate to the employment growth projected for the Boston MPO Region.

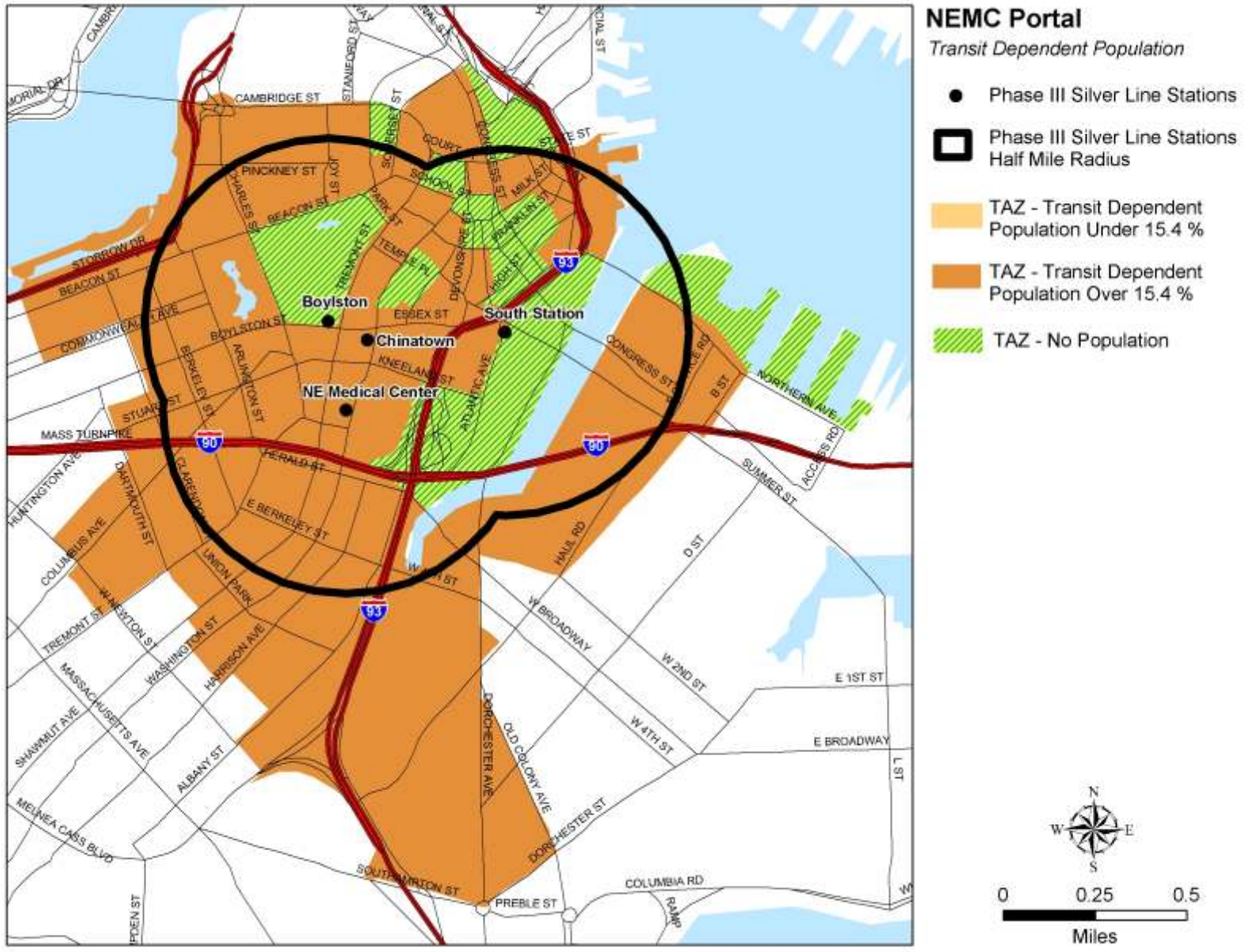
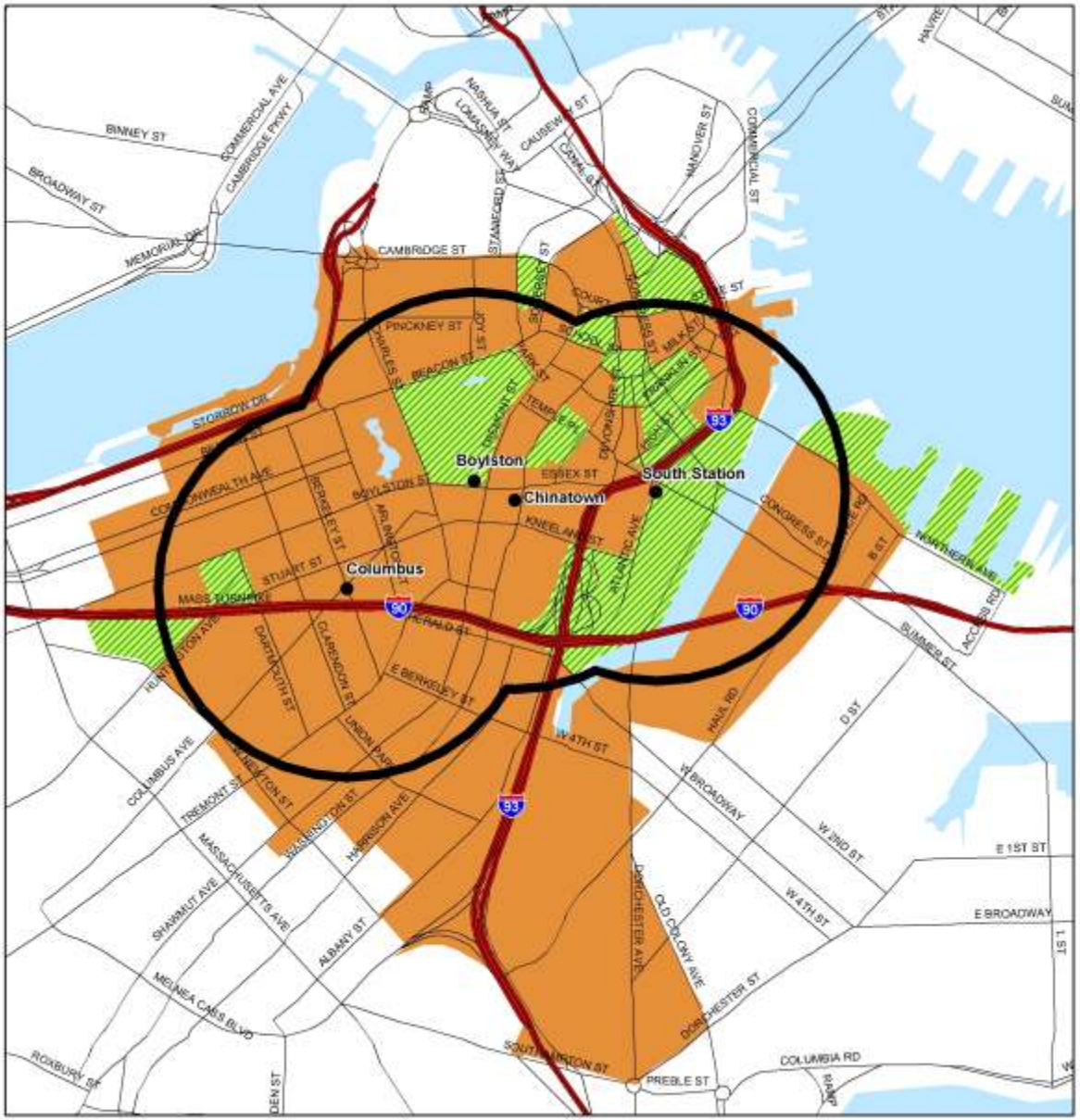


Figure 4.2-1
Transit Dependent Population
NEMC Portal



Columbus Avenue Portal

Transit Dependent Population

- Phase III Silver Line Stations
- Phase III Silver Line Stations Half Mile Radius
- TAZ - Transit Dependent Population Under 15.4%
- TAZ - Transit Dependent Population Over 15.4%
- TAZ - No Population

N W E S

0 0.25 0.5

Miles

Figure 4.2-2
Transit Dependent Population
Columbus Avenue Portal

4.2.4 Land Uses Along the Phase III Alignment Alternatives

This section describes specific land uses along the Phase III Core Tunnel Segment and each of the four alignment alternatives. Development densities are high for the Core Tunnel Segment and all alignment alternatives, development densities are high, with the typical building six to 10 stories high and set directly against the sidewalk. Most parking is structured, although a few surface parking lots exist. Curbside parallel parking is permitted on both sides of streets under which the alignment alternatives extend. Continuous sidewalks are also present on both sides of these streets. Land use details specific to the Core Tunnel Segment and each alignment alternative are presented below. Figure 4.2-3 shows major land uses along the Core Tunnel Segment; Figure 4.2-4 shows major land uses along the Tremont, Charles, Stuart alignments; Figure 4.2-5 shows major land uses along the Columbus Avenue alignment.

4.2.4.1 Core Tunnel Segment

This section describes specific land uses along the Core Tunnel Segment, from South Station to turnaround loop along Essex Street and Boylston Street. Development densities are high throughout the proposed alignment corridor, with the typical building six to 10 stories high and set directly against the sidewalk. Curbside parallel parking is generally permitted on both sides of Essex Street but only on the south side of Boylston Street. Continuous sidewalks are present on both sides of the streets along the segment. Figure 4.2-6 show typical land uses along the Core Tunnel Segment. Most parking is structured, although three surface parking lots are located along the route: one at Ping On Street between Edinboro and Oxford Streets, one at the southwest corner of Essex Street and Harrison Avenue, and one a block north of Essex Street between Washington Street and Harrison Avenue. There are no immediate plans to develop the first two lots, but the third lot is the site of Haywood Place, a proposed 12-story office building with ground floor retail. The first two above-ground levels will include up to 40,000 square feet of retail, while the remaining upper floors will be offices. A two-level underground parking garage for up to 153 vehicles will also be provided. Construction of Hayward Place is expected to begin in 2006.

Some of the highest development densities found along the Core Tunnel Segment occur near South Station. One Financial Center, a 46-story building with an underground parking garage, is located on the northwest corner of Essex Street and Atlantic Avenue. The office lobby, retail space, and a restaurant occupy the first two levels; the remainder of the building houses offices. Opposite One Financial Center, on the southwest corner of the intersection, is 695 Atlantic Avenue, an 11-story office building with ground floor retail. Just to the west of this building is an undeveloped parcel of land that presently serves as a parking lot. A 12-story office building on this parcel, Two Financial Center was proposed. The project proponent (Rose Associates) recently submitted a Notice of Project Change (NPC) to the Massachusetts Executive Office of Environmental Affairs (EOEA) proposing a 162 unit residential development with ground floor retail instead.[1] At the southwest corner of Essex and South Street is the eight-story Lincoln Plaza Building, which is being converted into residential condominiums. Opposite the Lincoln Plaza Building is a small triangular parcel of land currently used as a staging area for construction equipment associated with the Central Artery project. In the future, a pocket park will be constructed here.

A second, slightly larger park will be constructed south of Essex Street along a narrow portion of the Surface Artery between Essex and the Chinatown gate at Beach Street. Known as the Gateway Park, the park will feature bamboo trees, a small waterfall, and a 35-foot high semi-transparent structure representing the sail of a sampan.

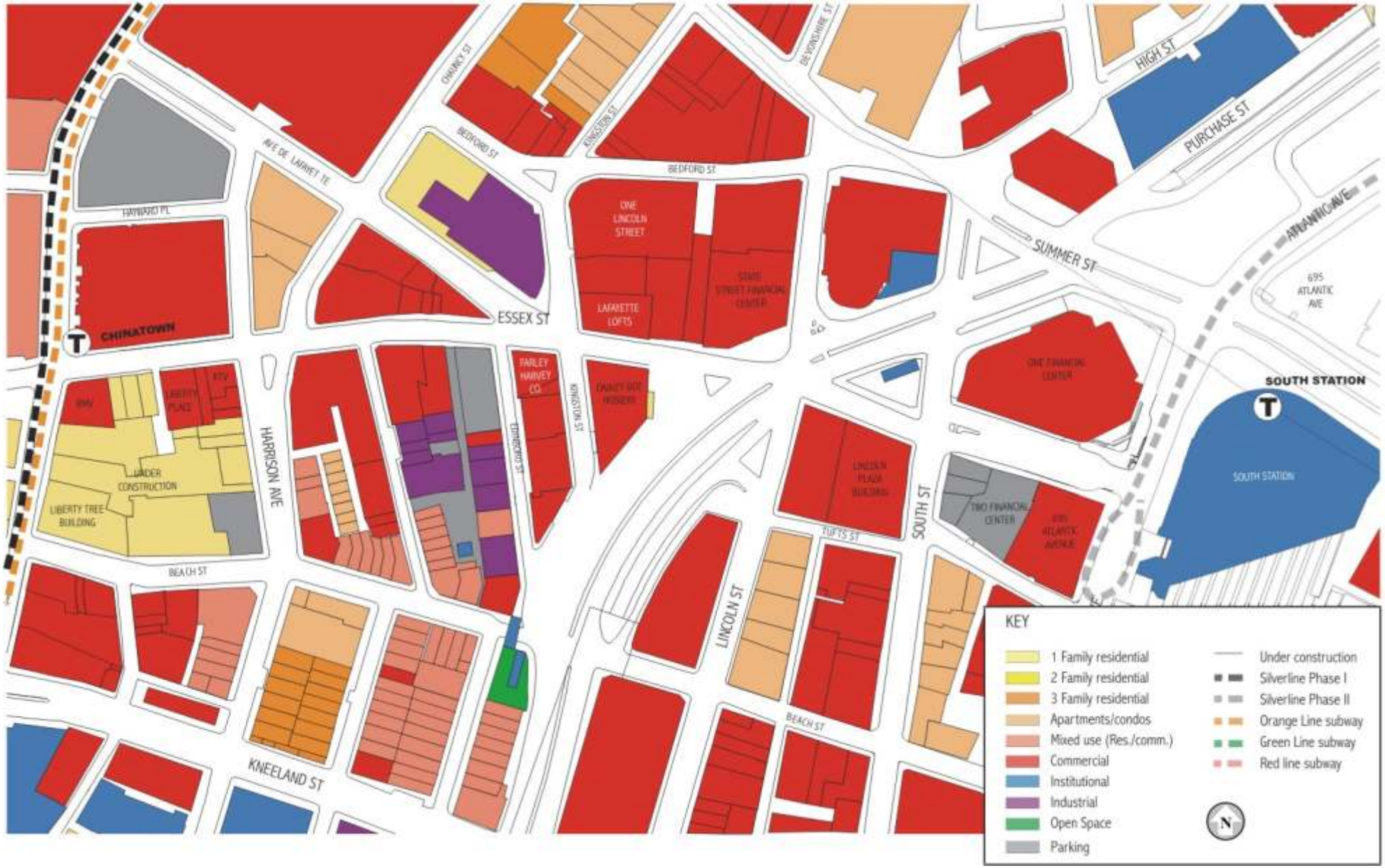


Figure 4.2-3
Major Land Uses - Essex Street between Atlantic Avenue and Washington Street

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.2-4
Major Land Uses
NEMC Portal Area

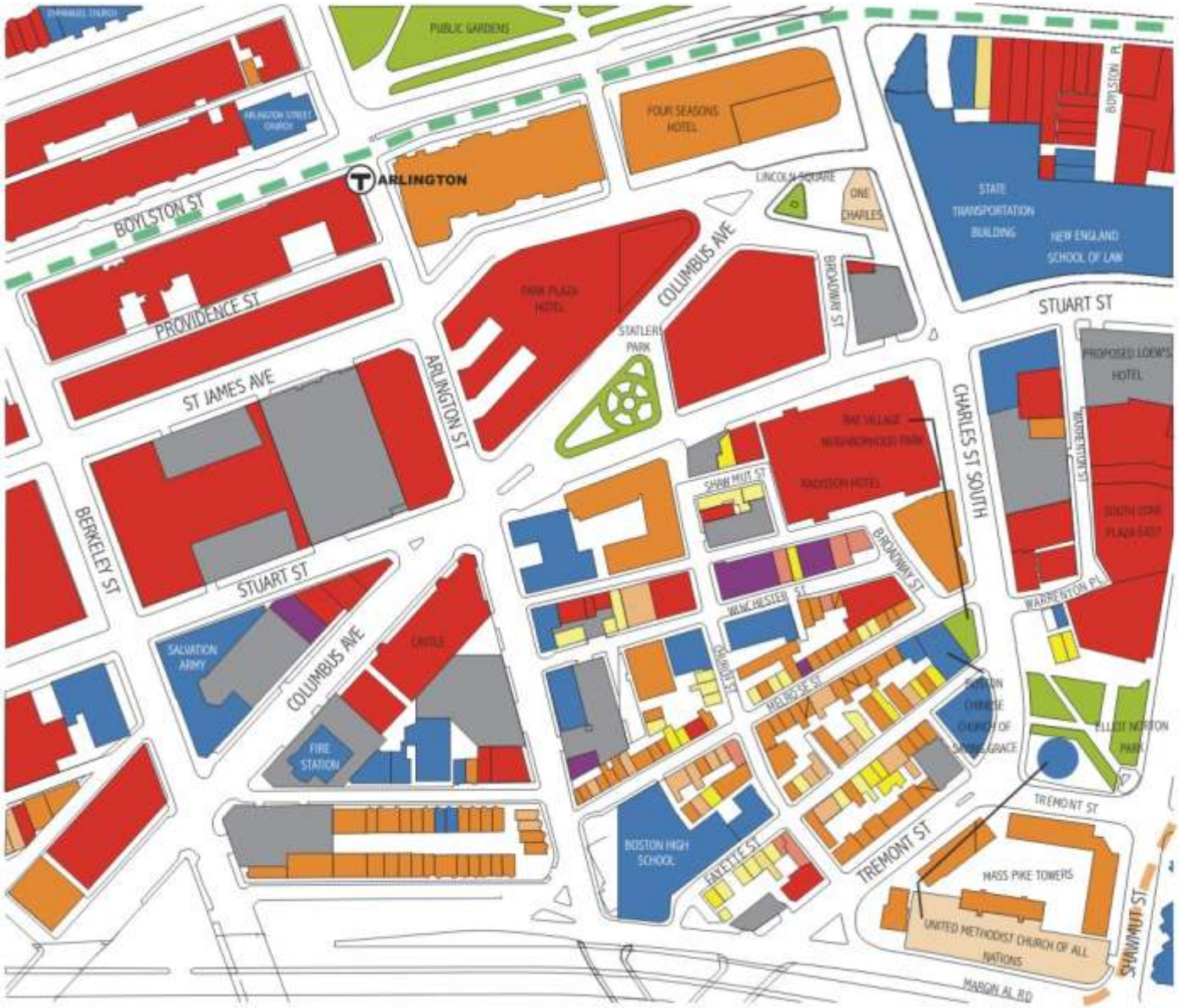


Figure 4.2-5
Major Land Uses
Columbus Avenue Alignment

Intersection of Boylston & Charles Streets (looking east)

Intersection of Boylston & Washington Streets (looking east)

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.2-6
Land Uses along the Core Tunnel Segment

West of the Surface Artery, Essex Street retains its historic character, owing to the presence of many early 20th century brick buildings that served a variety of industrial uses when this neighborhood was a center of leather and textile manufacturing. These buildings are typically six to eight stories high, and a few display their original names above their doors, such as Dainty Dot Hosiery and Farley Harvey Company. Several of these older structures are undergoing renovation. For example, Lafayette Lofts is a six-story residential loft development with ground floor retail. Farther west on Essex Street, near the intersection of Washington Street, several historic, four- to six-story buildings are also under renovation, with new ground floor retail being added to existing upper floor residences and offices.

Chinatown begins between Kingston and Chauncy Streets. Here, a more commercial and less industrial feel dominates, with offices (and occasionally apartments) in the upper floors and restaurants, food markets, electronics shops, and beauty salons on the ground floors. With the exception of the two-story Hollywood KTV lounge and its accompanying surface parking at the southwest corner of Essex Street and Harrison Avenue, buildings are eight stories high and are built to the edges of their property lines.

At the intersection of Essex and Washington Streets, signs of new development abound. Immediately behind the recently-renovated Liberty Tree Building, which sits on the southeast corner of Essex and Washington and houses the Department of Motor Vehicles, the Park Essex apartment complex is under construction on what was formerly a surface parking lot. When completed in the spring of 2006, Park Essex (formerly known as Liberty Place) will rise 28 stories and contain 373 market rate units, 66 affordable units, ground floor retail, and an underground parking garage. Across from this development, a 31-story apartment tower has been proposed for seven parcels of land at the corner of Washington and La Grange Streets, immediately behind the China Trade Building. The project, known as Kensington Place, will include 345 rental housing units, 15 percent of which will be affordable, 7,000 square feet of ground floor retail space and a four-level underground parking garage for up to 334 vehicles. At this time, no date has been set for the start of the construction. On the northwest corner of Essex and Washington intersection is the Ritz Carlton Hotel and Towers. The Towers contain ground floor retail, luxury condominiums, a luxury hotel, furnished residential suites, a sports club, a 19-screen cinema, an underground parking garage, and an entrance to the MBTA Chinatown Orange Line Station. Continuing west on Boylston Street (Essex becomes Boylston at the intersection of Washington Street), a parcel of land that until 2003 served as a parking lot has recently been developed into a six-story residential building with ground floor retail. The building, like others on the street, has been built to the edge of the sidewalk.

The Boylston Station Green Line headhouse is located on the northwest corner of Boylston and Tremont Streets. West of Tremont, development is located on the south side of Boylston Street only; the Boston Common abuts the north side of the street. The buildings fronting the sidewalk on Boylston Street are typically six to 10 stories high and consist of ground level retail (cafés, restaurants, book stores, music shops, etc.) with upper floor offices. Emerson College, the Colonial Theatre, the Handel and Haydn Society, and the entrance to the State Transportation Building, which includes a food court located on the ground floor, are also located on this section of Boylston Street. Behind the Colonial Theatre is Emerson College's new Tufte Performance Production Center. The Center houses the Department of Performing Arts and includes two theaters, two television studios, make up and costume labs, faculty offices and an exhibition area. The entrance to the 11-story, steel and glass building is at 10 Boylston Place.

4.2.4.2 Tremont Street Alternative

This section describes the specific land uses along the Tremont Street Alternative, south on Tremont Street from the intersection of Boylston Street, east on Oak Street, and south on Washington Street to the Massachusetts Turnpike Extension. Figure 4.2-7 show typical land uses along the Tremont Street Alignment.

Tremont Street (looking north)

NEMC Orange Line Station

Figure 4.2-7
Land Uses along the Tremont Street Alignment

South on Tremont Street from Boylston Street

Tremont Street between Boylston and Oak Streets is one-way southbound. Wide sidewalks are found on both sides of the street, but pedestrian amenities such as trees and benches are limited. Tremont Street is four lanes wide with no curbside parking between Boylston and Stuart Streets and five lanes wide including curbside parking on both sides between Stuart and Oak Streets. All buildings on Tremont Street abut the sidewalk. Only three undeveloped sites are found along the street, one of which is the proposed site of the NEMC portal.

The 12-story Little Building is located at 211 Tremont Street, at the southwest corner of Boylston and Tremont. The building is owned by Emerson College, and contains ground floor retail, college dining facilities, a function room, and dormitory rooms for 750 students. Immediately to the south is the 1,200-seat Cutler Majestic Theatre, owned and operated by Emerson College. Behind the Majestic is Emerson's 11-story Tufte Performance and Production Center. The Center is accessible to pedestrians via Boylston Place off of Boylston Street, and to delivery and service vehicles via an alley off of Tremont Street between the Little Building and the Majestic. The State Transportation Building abuts the Majestic, occupying the corner of Tremont and Stuart Street and extending along Stuart to the west. This wing of the building is six stories high and contains ground floor retail and upper floor offices.

The east side of Tremont Street contains a similar mix of retail, office, academic, and residential uses. Opposite the Little Building, at the southeast corner of Boylston and Tremont, is a 12-story building with a mix of ground floor retail and upper floor offices and residences. The Asian-American Civic Association (AACA) also occupies this building. To the south at 216 Tremont Street, is the 10-story Union Savings Bank Building. This former bank building is now owned by Emerson College and houses its Department of Communication Sciences and Disorders and its clinic for hearing-impaired children, and the offices of the Registrar, Student Financial Services, Health Services, Career Services, the Counseling Center and International students. The Bill Bordy Auditorium and Theater is located on the ground floor. South of the Union Savings Bank Building are six narrow buildings ranging in height from two to six-stories. All contain ground floor retail.

South on Tremont Street from Stuart Street

At the southwest corner of Tremont and Stuart Streets is a large surface parking lot. A 25-story Loews Hotel is planned for this site, with construction expected to begin in 2005. The top 10 stories of the hotel will be residential and the ground floor will include shops and a restaurant. An underground parking garage is also planned. Immediately to the south of the parking lot is a two story building, home to Dominic's Restaurant and Lounge. To the south of Dominic's is the 1,600-seat Shubert Theatre and the 12-story Courtyard Tremont Boston Hotel (formerly the Tremont Boston Hotel). This 300-room hotel includes a restaurant, lounge, and two nightclubs. To the south of the hotel is South Cove Plaza East. This seven-story apartment complex provides retail space on the ground floor and affordable rental housing for low-income seniors on the upper floors. Elliot Norton Park abuts South Cove Plaza.

On the southeast corner of Tremont and Stuart Streets, opposite the site of the future Loews Hotel, is another underutilized parcel targeted for development. This small parcel is owned by the BRA and is presently occupied by a temporary structure, a trailer housing a business that sells theater tickets. The BRA has issued a Request for Proposals in anticipation of eventual development.

South of the BRA parcel is the 1,200-seat Wilbur Theatre and the 3,600-seat Wang Center. Between the two theatres is the entrance to the New England Medical Center's Floating Hospital. The Floating Hospital is a 128-bed pediatric inpatient and ambulatory facility associated with Tufts-NEMC. This 11-story building abuts Tremont Street; the stage and seating area of the Wang Center is set back from Tremont, behind the Floating Hospital. Adjacent to the Floating

Hospital and connected by overhead pedestrian passageway, is a 10-story parking garage. The ground floor of the garage is occupied by the Chinese Cultural Institute and the Tremont Theatre. Adjacent to the parking garage is a surface parking lot. The lot is bounded on three sides by the parking garage, the Doubletree Hotel on Washington Street, and the Chinatown YMCA on Oak Street West.

East on Oak Street West from Tremont Street

An entrance to an underground MBTA Orange Line subway station is located at the northeast corner of Tremont Street and Oak Street West. Above the station is the three-story Wang YMCA of Chinatown, which fronts Oak Street West between Tremont and Washington Streets. Immediately north of the YMCA on Washington Street is the five-story, 267-room Doubletree Hotel. The ground floor of this building contains a restaurant and YMCA facilities. Immediately north of the Doubletree Hotel is the NEMC parking garage; the Silver Line portal proposed for this alternative would be located between the hotel and the NEMC parking garage.

On the south side of Oak Street, opposite the YMCA, is the 16-story Quincy Tower, owned by Quincy Tower Associates, a minority-owned company. The Greater Boston Chinese Golden Age Center runs an elderly daycare program on site.

South on Washington Street

Just north of Marginal Road, on the west side of Washington Street, is the four-story community school complex which houses South Cove Community Health Center, Josiah Quincy Elementary School, Boston Chinese Neighborhood Center and its recreation center. Opposite, on the east side of Washington, is the Josiah Quincy Upper School. Immediately to the north of the school is Oak Terrace, an 88-unit apartment complex comprised of a 10-story high-rise tower and four-story townhouse with family units.

Development in the immediate vicinity of the Massachusetts Turnpike Extension and Marginal Road is sparse. Pedestrian activity in this area is also limited.

4.2.4.3 Charles Street Alternative

This section describes the specific land uses along the Charles Street Alternative, from the intersection of Charles and Boylston to Tremont Street and east on Oak Street. Figure 4.2-8 show typical land uses along the Charles Street Alignment.

South on Charles Street South from Boylston Street

Charles Street South is one-way northbound. The street has three travel lanes, curbside parallel parking on both sides, and wide sidewalks.

The 272-room Four Seasons Hotel is located on the southwest corner of Boylston Street and Charles Street South. South of the Four Seasons is the 19-story “One Charles,” a new 230-unit luxury condominium complex that opened for occupancy at the end of 2004. One Charles includes ground floor retail and underground parking. Opposite One Charles is the seven-story State Transportation Building, which also includes ground floor retail and an underground parking garage. On the southwest corner of Charles Street and Stuart Street is the 20-story, 356-room Radisson Hotel (formerly Howard Johnson’s 57 Motor Hotel). The hotel sits atop a five-story parking garage with ground floor retail. Opposite the Radisson, on the southeast corner of Charles and Stuart, is the five-story New England School of Law.

Intersection of Charles Street and Warrenton Place (looking north)

Charles Street (looking south)

Figure 4.2-8
Land Uses along Charles Street Alignment

South of the Radisson, lower development densities prevail, and the character of the neighborhood becomes more residential. On the west side is a five-story apartment building with ground floor retail; Bay Village Park, a small "pocket park"; the Boston Chinese Church of Saving Grace; and more three-story residences with ground floor retail. On the east side of Charles Street is a succession of historic buildings, dating to the 18th-century, that escaped urban renewal in the 1960s.

These include a five-story brownstone that is home to the 64-room Hotel Milner, and four historic homes on Lyndeboro Place at the edge of Elliot Norton Park. The park, located on the east side of Charles Street, is bounded on the south and east by Tremont Street (which makes a 90-degree turn at the southeast corner of the park). The circular, windowless United Methodist Church of All Nations and a small parking lot associated with the church are located on the southern edge of the park, abutting the sidewalk along Tremont Street.

East on Oak Street West from Tremont Street

An entrance to an underground MBTA Orange Line subway station is located at the northeast intersection of Tremont Street and Oak Street West. Above the station is the three-story Wang YMCA of Chinatown, which fronts Oak Street West between Tremont and Washington Streets. Opposite the YMCA on the south side of Oak Street is the 16-story Quincy Tower, owned by Quincy Tower Associates, a minority-owned company. The Greater Boston Chinese Golden Age Center runs an elderly daycare program on site.

4.2.4.4 Stuart Street Alternative

This section describes specific land uses along the Stuart Street Alternative, from the intersection of Boylston Street and Charles Street South to the portal at New England Medical Center on Washington Street. Figure 4.2-9 show the typical land uses along the Stuart Street Alignment.

South on South Charles Street from Boylston Street

The 272-room Four Seasons Hotel is located on the southwest corner of Boylston Street and Charles Street South. South of the Four Seasons is the 19-story "One Charles," a new 230-unit luxury condominium complex. One Charles includes underground parking and ground floor retail (not yet leased out). Opposite One Charles is the seven-story State Transportation Building, which also includes ground floor retail and an underground parking garage. On the southwest corner of Charles Street and Stuart Street is the 20-story, 356-room Radisson Hotel (formerly Howard Johnson's 57 Motor Hotel). The hotel sits atop a five-story parking garage with ground floor retail. Opposite the Radisson, on the southeast corner of Charles and Stuart, is the five-story New England School of Law.

East on Stuart Street from Charles Street

Between Charles and Tremont Streets, Stuart Street is a two-way, four-lane road with metered parallel parking on both sides. Fronting the entire block on the north side is the State Transportation Building, the ground floor of which is occupied by Bennigan's Grill and Tavern, and other, smaller food and retail establishments. The upper floors are offices. On the south side of Stuart Street is the New England School of Law, where approximately 1,100 students are enrolled in part- and full-time J.D. programs. A large surface parking lot is located adjacent to the law school and opposite the main entrance to the Transportation Building. A 25-story Loews Hotel is planned for this site, with construction expected to begin in the spring of 2005. The top 10 stories of the hotel will be residential and the ground floor will include shops and a restaurant. An underground parking garage is also planned.

Stuart Street (looking east)

Intersection of Tremont and Charles Streets (looking south)

Figure 4.2-9
Land Uses along the
Stuart Street Alignment

South on Warrenton Street from Stuart Street

Warrenton Street is a short, narrow street that intersects Stuart Street mid-block between Charles and Tremont Streets. It runs south parallel to Charles Street for approximately 400 feet, then turns 90 degrees to the west and connects to Charles Street. It is one-way (in the direction of Stuart Street), with metered parking on one side. Along the west side of Warrenton Street, immediately behind the New England School of Law, are two early 19th century brick buildings: a three-story building located at 100 Warrenton and occupied by Nick's Comedy Stop and the Venu and RumoR nightclubs, and a five-story brick apartment building. Adjacent to the apartment building is a small, empty surface parking lot enclosed by a high chain link fence. The parking lot contains a substation or other electric apparatus and appears to be the property of NSTAR Electric, whose name appears on the door of the four-story warehouse-like building next door. The building is windowless and contains front and back loading docks. Its address is 70-74 Charles Street South. Adjacent to the NSTAR building is the 525-seat Charles Playhouse, an active off-Broadway playhouse that occupies a building originally designed and built in 1839 as a church. Shear Madness and Blue Man Group, two of the longest-running shows in Boston, are performed here.

The east side of Warrenton Street is dominated by the parking lot that is the site of the future Loews Hotel, and by the windowless back sides of Dominic's Restaurant, the Shubert Theatre, and the Courtyard Tremont Boston Hotel. All three structures front Tremont Street. A small surface parking lot occupies an undeveloped parcel between the theater and hotel. Back entrances to Chippendale's nightclub and the South Cove Plaza East apartment complex are also located on the east side of Warrenton. At South Cove Plaza, Warrenton turns sharply to the west and meets Charles Street. At this intersection, adjacent to the Charles Playhouse and the Milner Hotel, which sit back-to-back fronting Warrenton Street and Charles Street, respectively, is a small undeveloped parcel of land owned by the BRA. Part of the parcel is landscaped and the rest is occupied by a one-story, semi-permanent structure made of corrugated steel. The structure is used by the Charles Playhouse.

South on Tremont Street from Stuart Street

A parking lot (and future Loews Hotel) occupies the southwest corner of Stuart and Tremont Streets. Immediately to the south is a two-story building, home to Dominic's Restaurant and Lounge. To the south of Dominic's is the 1,600-seat Shubert Theatre and the 12-story Tremont Boston Hotel (formerly the Wyndham Tremont). This 300-room hotel includes a restaurant, lounge, and two nightclubs. To the south of the hotel is South Cove Plaza East. This seven-story apartment complex provides retail space on the ground floor and affordable rental housing for low-income seniors on the upper floors. Elliot Norton Park abuts South Cove Plaza.

On the southeast corner of Tremont and Stuart Streets, opposite the site of the future Loews Hotel, is another underutilized parcel targeted for development. This small parcel is owned by the BRA and is presently occupied by a temporary structure, a trailer that sells theater tickets.

South of the BRA parcel is the 1,200-seat Wilbur Theatre and the 3,600-seat Wang Center. Between the two theaters is the entrance to the New England Medical Center's Floating Hospital. This 11-story building abuts Tremont Street; the stage and seating area of the Wang Center is set back from Tremont, behind the Floating Hospital. Adjacent to the Floating Hospital and connected by an overhead pedestrian passageway, is a 10-story parking garage. The ground floor of the garage is occupied by the Chinese Cultural Institute and the Tremont Theatre. Adjacent to the parking garage is a surface parking lot. The lot is bounded on three sides by the parking garage, the Doubletree Hotel on Washington Street, and the Chinatown YMCA on Oak Street West.

4.2.4.5 Columbus Avenue Alternative

This section describes specific land uses along the Columbus Avenue Alternative, from the intersection of Charles Street South and Boylston Street to the portal at the Salvation Army Headquarters on Columbus Avenue. Figure 4.2-10 show the typical land uses along the Columbus Avenue Alignment.

South on South Charles Street from Boylston Street

The 272-room Four Seasons Hotel is located on the southwest corner of Boylston and South Charles Streets. South of the Four Seasons at the intersection of South Charles Street and Stuart Street is the 19-story "One Charles," a new 230-unit luxury condominium complex.

Park Plaza

Park Plaza is located at the intersection of Columbus Avenue and Charles Street South immediately to the south of the Four Seasons Hotel. This area was recently restored as a pedestrian plaza.

Southwest on Columbus Avenue from Park Plaza

This portion of the alignment corridor extends two blocks or approximately three-tenths of a mile southwest on Columbus Avenue from Park Plaza to the intersection of Berkeley Street. The street itself is generally wide, with wide travel lanes and sidewalks on both sides. With some exceptions, buildings are built to the edges of their property lines and vary in height from two to 14 stories. Most buildings are mixed-use, with ground floor retail (predominantly restaurants) and upper floor office. Parking is available in the form of curbside metered parking, surface parking lots, and parking garages (both underground and above ground). Despite an active street life, this portion of the corridor is more auto-oriented than the Core Tunnel Segment, owing to the width of the roadway and intersections, the number of parked vehicles on- and off-street, the active truck loading zone on the south side of the Park Plaza Hotel, and the proximity of the Massachusetts Turnpike. Although Tremont Street and Charles Street South are also wider and more auto-oriented than both Essex Street and Boylston Street, from the pedestrian's perspective, the difference is not so striking. Only Columbus Avenue combines wide streets and intersections with abundant parking, active loading zones, and the proximity of an eight-lane highway (the Massachusetts Turnpike).

Southwest of Park Plaza is the 14-story Boston Park Plaza Hotel, with ground floor restaurants. Opposite the hotel is an eight-story parking garage with ground floor retail and restaurants. A triangular pedestrian plaza (Statler Park) is located adjacent to the garage, at the intersection of Columbus Avenue, Church Street, and Stuart Street. Southwest of the plaza is the broad, six-way intersection of Columbus Avenue, Stuart Street, and Arlington Street. On the south side of the intersection is the eight-story South Cove Plaza West mixed-use development (230 Stuart Street) and the 14-story Boston Renaissance Charter School (250 Stuart Street). South Cove Plaza provides retail space on the ground floor and affordable rental housing for low-income seniors on the upper floors. The charter school, which opened in 1995, enrolls 1,400 students from preschool through grade 8.

Continuing southwest on Columbus Avenue, the street becomes wider and the building heights lower. On the south side of Columbus, at the intersection of Arlington Street, is the Castle at Park Plaza, a stone and brick medieval-style structure constructed in 1891. The Castle is five stories high, not including its turret, and originally served as the headquarters for the First Corps of Cadets, the Commonwealth's volunteer militia. Today the building is occupied by the Smith and Wollensky restaurant and provides a venue for special events. Adjacent to the Castle is 162 Columbus Avenue, a five-story brick building. The ground floor is occupied by the Piattini Wine

Park Plaza Hotel - Columbus Avenue Entrance

Columbus Avenue (looking east)

Figure 4.2-10
Land Uses along the Columbus Avenue Alignment

Bar and the upper floors are office space. Adjacent to 162 Columbus is a two-story City of Boston fire station with four garage doors opening onto the street. The fire station, in contrast to most buildings on Columbus, is not built to the lot line but is set back to facilitate entry and exit of emergency vehicles and to provide employee parking. For this reason, the building and the part of the block it occupies at the northeast corner of Columbus Avenue and Isabella Street has a lower-density feel to it. Three additional surface parking lots are located in the immediate vicinity of the fire station – one directly across the street and two immediately to the southwest on either side of Berkeley Street at Columbus.

In the coming years, new development will transform the area to the south of Berkeley and Columbus as Columbus Center rises over the Massachusetts Turnpike Extension a few hundred yards to the south. Columbus Center is a predominantly residential project, composed of four parcels totaling approximately seven acres. It is bordered by Clarendon Street on the west, Tremont Street on the east, Cortes and Stanhope Streets on the north, and the Amtrak rail lines on the south. The project will include approximately 500 residential units (rental, condominium, and affordable), 37,000 square feet of new open space, a 200-room boutique hotel, 50,000 square feet of retail (including a health club, grocery store, daycare center, and café), underground parking for 286 vehicles, and an above-ground parking garage for 633 vehicles. Construction is expected to begin in 2005.

Opposite Piattini and the fire station, and occupying the entire Columbus Street block between Berkeley and Arlington Streets, is a row of three-, four-, and five-story buildings punctuated by a surface parking lot. Some of the building entrances are located on Columbus, while others are located on the opposite side of the buildings on Stuart Street. At the northeast corner of the block, at the corner of Stuart Street and Columbus Avenue, is a three-story, wedge-shaped brick building. One of two ground floor storefronts is occupied by Viga Italian Eatery, whose address is 304 Stuart Street, but the second storefront is vacant. The second and third floors also appear vacant or underutilized and the building as a whole is in need of repair. The five-story brick building adjacent to Viga is newly-renovated and in better condition. The ground floor is occupied by Flash's Cocktails and the upper stories are offices. Adjacent to Flash's are two older four-story brick buildings, whose ground floor is occupied by Baptiste Power Yoga and Benjamin Franklin Printers, respectively. Benjamin Franklin's loading dock is located on the Columbus Avenue side of the building. A surface parking lot used by the Salvation Army occupies the empty site adjacent to this building. Adjacent to the parking lot, on the corner of Columbus Avenue and Berkeley Street is the Salvation Army Headquarters, a five-story grey stone structure built in 1950.

North on Berkeley Street to Stuart Street

While the proposed alignment includes Columbus Avenue only, a survey was made of land uses on Berkeley Street one block to the north and on Stuart Street between Berkeley and the corner of Arlington/Columbus. Berkeley Street north of Columbus is one-way, with three northbound lanes of traffic and curbside parking and wide sidewalks on both sides. The MBTA's Route 39 bus travels briefly along this stretch of Berkeley before turning west on St. James Avenue. The Pledge of Allegiance Building (where the Pledge of Allegiance was written and published in 1892) is located at the southwest corner of Columbus and Berkeley, a five-story brick building with mixed uses. The ground floor is occupied by Mitchell Gold home furnishings and the Laurel Grill and Bar, while the upper floor is occupied by offices, health clinics, and the Boston Bartending School. Immediately north of the Pledge of Allegiance Building is the former Police Department Headquarters, now a Jurys Boston Hotel. Jurys is a nine-story, 220-room boutique hotel with a ground floor restaurant and bar. An outdoor café is located in front of the building below street level. A 10-story mixed-use building, 330 Stuart Street, is opposite the hotel, at the southeast corner of Berkeley and Stuart Streets, just north of the Salvation Army Headquarters. The building was purchased in October 2004 by Liberty Mutual Group, which employs 1,700 employees at its corporate headquarters at 175 Berkeley Street, on the northeast corner of Stuart and Berkeley. The ground floor of 330 Stuart Street is occupied by the Grill 23 Bar and

Restaurant and the upper floors are offices. Diagonally across from 161 Berkeley, at the northwest corner of Berkeley and Stuart Streets, is the 26-story old Hancock Building, built in 1947.

Although not adjacent to the proposed alignment, one additional project in this part of the Back Bay is worth noting. One block to the west of Berkeley Street, at the southeast corner of Stewart and Clarendon Streets, a mixed use development known as the Clarendon has been proposed. The site currently consists of three parcels of land: a surface parking lot, a three- to four-story brick building occupied by the U.S. Post Office, and a nine-story building occupied by the Hard Rock Café and several office tenants. The Clarendon will include 400 residential units (rental, condominium, and affordable), a restaurant, post office facilities, and underground parking for 393 vehicles, including Zipcars. The project will accommodate existing on-site uses, including the Hard Rock Café and office space.

East on Stuart Street to Arlington Street/Columbus Avenue

Stuart Street between Berkeley and the corner of Arlington/Columbus is one-way, with two travel lanes and curbside parking and wide sidewalks on both sides. Because Stuart intersects Arlington/Columbus at a sharp angle, the north side of the block is longer than the south side. Number 330 Stuart Street runs for half the south side of the block. The remaining four buildings on the block are those occupied by Benjamin Franklin Printers, Baptiste Power Yoga, Flash's and Viga. All four buildings have doors on both the Columbus and Stuart sides. Building heights are the same on both sides, with the exception of the building occupied by Benjamin Franklin, which is three stories high facing Columbus but only one story high facing Stuart.

Liberty Mutual's Corporate Headquarters runs for half the north side of the block. The Liberty Mutual building is 10-stories high and has a moderate setback permitting off-street parking in front for two rows of vehicles. An entrance to an underground loading dock is located at the east side of the building, adjacent to the entrance to an underground public parking garage below the neighboring building, 333 Stuart Street. The 333 Stuart Street building is approximately 20 stories high and is occupied by Landry & Arcari Interiors on the ground floor and by offices on the upper floors. The building is connected by means of a glass atrium to a 10-story office building to the east, 75 Arlington Street. Restaurants and cafés occupy the ground floor of the atrium. Davio's Italian restaurant occupies the remainder of the ground floor of 75 Arlington.

4.2.5 Zoning

As described previously, the Silver Line, particularly Phase III, is being constructed in a very dense urban environment. As demonstrated by the recent and proposed projects described in the previous section, strong demand for new or expanded commercial, residential, and institutional uses in the corridor causes significant development pressures on the relatively few parcels available for redevelopment. Phase III of the Silver Line falls within the regulations of three of Boston's downtown zoning districts: the Midtown Cultural District, the Chinatown District, and the South Station Economic Development Area. Each of these districts, described below, has a distinct character which the BRA protects through its project review process.

4.2.5.1 Midtown Cultural District

The goals and objectives of the Midtown Cultural District zoning code are to direct downtown development in a way that promotes balanced growth for Boston; to prevent over-development of the Financial District and the Back Bay by promoting mixed-use development in Midtown; to revitalize Midtown as the region's center for performing and visual arts by rehabilitating theaters and creating new cultural facilities for the city's nonprofit arts community; to protect the quality of life and provide for expansion of the thriving Chinatown neighborhood by creating affordable housing and business opportunities, and by controlling institutional expansion in the area; to

preserve Boston's historic resources and public open spaces, which provide enjoyment to all residents and visitors and which increase land values in their proximity, by virtue of historic, aesthetic, and environmentally beneficial qualities; to provide new and expanded facilities for community services; and to create a new residential neighborhood which is affordable to all segments of the community.

In support of these goals, floor area ratios have been set within the Midtown Cultural District to allow building heights of 125 feet and a floor area ratio of eight. Proposed projects may increase their heights to 155 feet and a floor area ratio of 10 subject to compliance with the Large Project Review and with receipt of a Certificate of Compliance pursuant to Section 80B-6 of Boston's zoning code. An exception to these limitations is provided for housing development. Within a Housing Priority Area, pursuant to Section 38-5, heights are increased to 250 feet with a floor area ratio of 12. This dense multi-use neighborhood relies on public transit services as the backbone of its transportation network. The neighborhood is linked to existing areas served by transit but is currently lacking convenient access to the developing Waterfront area. The Silver Line would provide needed waterfront access for this district.

4.2.5.2 Chinatown District

Zoning in the Chinatown District is used to upgrade the quality of life and ensure the long-term viability of Chinatown as an historic residential neighborhood and a unique cultural, business, and service center; to create housing which is affordable to all segments of the community; to encourage community businesses and trades; to diversify the economy and improve employment opportunities for neighborhood residents; to protect the historical and cultural resources of the district; to improve the environment through the establishment of open space subdistricts; to manage institutional growth in an open process and to establish boundaries for institutional uses; to promote the most desirable use of land in accordance with the Chinatown Community Plan; and to promote the public safety, health, and welfare of the people of Boston.

Building heights and floor area ratios have been established in support of these goals. The building height for any project within Chinatown is subject to dimensional regulations by the specific Chinatown Planned Development Area, and range from 175 to 300 feet. Floor area ratios in this district range from six to 10.

Key to the protection of the Chinatown District is maintaining its neighborhood characteristics. As with Midtown, this dense neighborhood relies on public transit services as the backbone of its transportation network. Currently the area is served by public transit with the MBTA's Orange Line service at Chinatown Station, but it is currently lacking convenient access to the developing Waterfront area. The Silver Line would provide needed waterfront access for this district.

4.2.5.3 South Station Economic Development Area

Zoning regulations for the comprehensive plan for the South Station Economic Development Area (EDA) are used to direct downtown development in a way that promotes balanced growth for Boston; to channel growth away from the congested areas and towards underutilized sites in the Bedford-Essex corridor and along the Fort Point Channel; to permit redevelopment which provides significant community benefits in accordance with city land disposition policies; to create a mixed-use district which includes office, retail, hotel, research and development, and biomedical uses; to provide an area in the downtown to enhance the expansion of Boston's biomedical and research and development sectors; to create a complex of facilities and services that will foster economic growth in Boston and throughout the region; to increase the number of jobs in those sectors of the economy likely to employ Boston residents; to promote the creation and incubation of new research and development businesses and uses along with the facilities to support such uses; to create a transition of uses and character between the downtown and Chinatown and Leather Districts; to utilize existing transit centers; and to improve vehicular access to the city by establishing parking facilities near major commuter arteries.

The zoning regulations for the South Station EDA support large scale high-density development. In all areas with the exception of the Parcel-to-Parcel Linkage Development Area and the New Economy Development Area, projects within the South Station EDA are allowed a building height of 300 feet and a floor area ratio of 12. Within the Parcel-to-Parcel Linkage Development Area even larger projects are permitted with a building height limitation of 465 feet and a floor area ratio of 14. Buildings within the New Economy Development Area have an allowed height of 300 feet and floor area ratio of 12. Projects with heights of 400 feet and floor area ratios of 14 can be permitted if approved through the Planned Development Area (PDA) Review process. The Massachusetts Turnpike Authority is currently soliciting proposals for approximately 1.7 million square feet of residential, commercial, and civic development, to be developed on 10 acres of air rights above the new Central Artery ramps in the South Station EDA area, south of the existing Leather District and east of Chinatown.

The scale of the developments within the South Station EDA will require efficient public transit services to move people into and out of the area. Built around one of two MBTA downtown transit hubs (North Station is the other hub), the South Station intermodal facility provides regional connections to the south through the commuter rail network, commuter and intercity bus, as well as Red Line connections to Ashmont, Braintree, and Cambridge. The addition of the Silver Line service will provide further connections to areas currently without a direct connection to the South Station and the Waterfront areas.

4.3 Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."[2] The order requires each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations…."[3] Between 1997 and 2000, the U.S. Department of Transportation and the Council on Environmental Quality issued their own environmental justice policies, which support Executive Order 12898 in the development, environmental review, and implementation of transportation projects.[4] These environmental justice policies encompass two fundamental principles:

- To identify and address any disproportionately high and adverse human health and environmental effects, on minority populations and low-income populations; and
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.

Analysis of environmental justice (EJ) issues for the Silver Line Phase III project includes three elements:

- A description of the communities within the Phase III corridor, and the extent to which they meet EJ criteria as minority or low-income populations (discussed in this chapter);

[2] Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 59 Fed. Reg. 7629 (Section 1-101) (1994), 3 C.F.R. §859, reprinted in 42 U.S.C. §4321.

[3] E.O. 12898, at §1-101.

[4] U.S. DOT, *Order to Address Environmental Justice* (April 15, 1997); CEQ, *Environmental Justice Guidance under NEPA* (Dec. 10, 1997).

- A description of the public involvement process for the project, and how it has supported the identification of EJ community concerns (discussed in Chapter 8.0); and
- An assessment of whether the Phase III project, taking into account measures to avoid, minimize, and mitigate impacts, will have any disproportionately high and adverse effects on EJ communities in the Silver Line Corridor (discussed in Chapter 5.0).

4.3.1 Identification of Environmental Justice Communities

Executive Order 12898 and the DOT Order do not contain specific criteria for identifying minority and low-income populations (termed here "Environmental Justice (EJ) Communities"). Therefore, this analysis looks to criteria that have been developed by the Boston Metropolitan Planning Organization (MPO) organization, acting pursuant to federal transportation planning guidelines to serve as guides.

The Boston MPO, as part of its regional transportation planning efforts, has developed its own criteria to identify "Populations of Concern" with respect to environmental justice.[5] For the purpose of identifying EJ populations within Silver Line Phase III catchment area, the following Boston MPO criteria for low income and minority populations have been used to define an EJ population:[6]

- The median household income is at or below 75 percent of the median income for the metropolitan area (i.e., income is less or equal than $41,850); or
- 21.4 percent of the residents are minority.

Using these criteria, the Boston MPO has identified 17 neighborhoods for environmental justice, or Communities of Concern, within the Boston region. These Communities of Concern were identified "based on the density of low-income and minority population residing in them." The Silver Line Phase III, as well as the full build Silver Line area, encompasses some of these Communities of Concern, including Chinatown, South End, and Roxbury. To make the analysis more fine-grained, the standard population unit that has been employed is the smaller traffic analysis zone (TAZ) that is also defined in the Boston MPO's regional transportation plan[7].

Using 2000 Census data, demographic statistics that describe each of the EJ criteria were identified for neighborhoods falling within a half-mile radius of the Silver Line Phase III stations for the alternatives. These same statistics were also identified for the entire Silver Line route (i.e., between Dudley Square and the Waterfront area/Logan Airport), since the Phase III project will improve transit service for populations throughout the Silver Line service area. For comparison,

[5] Boston MPO, *Regional Transportation Plan 2004-2025,* Chapter 6: Environmental Justice Assessment of the Transportation System. Page 6-2. In addition, the Executive Office of Environmental Affairs (EOEA) of the Commonwealth of Massachusetts issued an Environmental Justice Policy in October 2002, which includes criteria for defining an "Environmental Justice Population." EOEA Policy, pp3, 5. However, these criteria are less inclusive than the MPO's criteria. Note also that although the EOEA Policy provides for enhanced review under MEPA for the impacts upon EJ Populations of projects that exceed certain thresholds, the Silver Line Phase III Project does not exceed any of these thresholds, and such review was not required in the Secretary's Certificate on the NPC. See EOEA Policy, §§ 14 & 15.

[6] In addition, for regional transportation planning purposes the Boston MPO uses a criterion of "transit-dependent households." Since this criterion lies outside the federal requirement to assess disproportionate impacts on minority and low income populations, analysis of transit-dependency is incorporated into this document at Section 4.2.2 of this Chapter, as part of the analysis of Socioeconomics and Land Use.

[7] A traffic analysis zone (TAZ) is an area delineated by transportation officials and analysts to tabulate traffic-related data. TAZs are comprised of one or more census blocks, block groups or census tracts. In general, TAZs boundaries will be defined by roadways or other geographic features (e.g., rivers), and the socio-economic characteristics within each TAZ will be homogeneous. The socio-economic and EJ analysis was conducted at the TAZ level to ensure consistency with MAPC population and employment projections (which are only available at the TAZ level) and with the EJ analysis performed by CTPS as part of the Boston MPO 2004-2025 Regional Transportation Plan.

statistics also were also compiled for the City of Boston as a whole. Tables 4.3-1 and 4.3-2 show a summary of this analysis. The Silver Line Phase III area for the NEMC portal alternative (Tremont, Charles, and Stuart) is comprised of all or part of 45 TAZs; however of these 45 TAZs, only 31 are populated. The Columbus Avenue portal alternative is comprised of all or part of 53 TAZs, of which 37 are populated.

Just over 50 percent of all populated TAZs within the Silver Line Phase III catchment area for the four alignment alternatives meet at least one of the criteria for environmental justice.

Table 4.3-1 – Environmental Justice Criteria – Summary of Statistics

	Population	Minority Population (percent)	Households	Median Income
NEMC Portal – Tremont/Charles/Stuart Alternatives				
Silver Line Phase III	20,851	8,891 (42.6%)	10,536	$47,476
Full Build Silver Line	57,630	30,711 (53.3%)	28,078	$44,015
				Columbus Avenue Alternative
Silver Line Phase III	29,899	11,600 (38.8%)	15,796	$54,864
Full Build Silver Line	62,159	31,603 (50.8%)	30,928	$46,247
City of Boston	589,141	297,580 (50.5%)	239,528	$39,629

Sources: U.S. Department of Commerce, United States Census 2000; CTPS.

Table 4.3-2 – Environmental Justice Criteria - Results

	Percent of Populated TAZs Meeting EJ Criteria	
Environmental Justice Criteria	**Phase III NEMC Portal Alternatives**	**Phase III Columbus Avenue Alternative**
Median Household Income less than $41,850	38.7%	32.4%
Minority Population greater than 21.4 percent of Total Population	38.7%	43.2%
Defined as EJ community (meets at least one of the above criteria)	51.6%	51.3%

Sources: U.S. Department of Commerce, United States Census 2000; CTPS.

4.3.1.1 Income

The chosen criterion for income defines an EJ community as one in which the median income is at or below 75 percent of the MPO median. According to the 2000 Census, the Boston MPO median household income is $55,800; therefore, a community with a median household income at or below $41,850 meets the EJ income definition.

The average median household income for the TAZs within the Silver Line Phase III area is above the EJ threshold. For the Tremont/Charles/Stuart Street alternatives, the average median household income is estimated at $47,476, which is higher than the average median household income for both the full build Silver Line and the City of Boston. On the other hand, the Tremont/Charles/Stuart Street alternatives serve 12 TAZs (or 38.7 percent of the populated TAZs) where the median household income is below $41,850.

For the Columbus Avenue alternative, the average median household income is estimated at $54,864, which is higher than the average median household income for both the full build Silver Line and the City of Boston. This alignment serves 12 TAZs (or 32.4 percent of the populated TAZs) where the median household income is below $41,850.

Figures 4.3-1 and 4.3-2 show a significant concentration of population with median household income below $41,850 around the Silver Line Phase III stations, including Chinatown and South End residents.

The average income within the catchment areas for the four Silver Line Phase III alternatives does not meet the low income criterion. However, over 30 percent of the population within the Silver Line Phase III catchment area meet the criterion for low income.

4.3.1.2 Minority Population

The chosen criterion for minority population defines an EJ community as one in which the minority population accounts for 21.4 percent or more of the total population. Almost 43 percent of the population within half-mile of the Tremont/Charles/Stuart Street alternatives is classified as minority. As a whole, over 50 percent of the population within a half-mile of the full build Silver Line is considered a minority population. Twelve TAZs within the Tremont/Charles/Stuart Street alternatives area meet the EJ criteria for minority population, accounting for almost 39 percent of the total populated TAZs within the area. By comparison, in the City of Boston, 50 percent of the total population is classified as minority.

For the Columbus Avenue alternative, the minority population accounts for almost 39 percent of the total population within the Silver Line Phase III catchment area. Sixteen TAZs contain a minority population of 21.4 percent or higher, accounting for 43.2 percent of the populated TAZs within the area.

Figures 4.3-3 and 4.3-4 show the minority populations within the Silver Line Phase III alternatives. Minority populations include the communities of Chinatown, South End, and Roxbury. The communities within a half-mile distance of the Silver Line Phase III station for each of the four alignment alternatives meet the criterion that defines minority population.

4.4 Traffic and Parking

This section presents existing (2004) traffic conditions within the study area, including an inventory of roadways, a summary of traffic volumes, and level of service (LOS) analysis. Since the Silver Line vehicle will be running primarily underground, only its surface route will affect traffic. Traffic analyses in this report will mainly focus on impacts of the Silver Line services around the proposed portal locations at NEMC portal and Columbus Avenue, since this is where changes in traffic would occur with Silver Line Phase III operations, depending on the alternative selected.

4.4.1 Study Area/Methodology

4.4.1.1 Methodology

For transportation related issues, the study area comprises all streets that could be potentially affected by the operational phase of each of the Silver Line Phase III Build Alternatives. Construction phase traffic issues are discussed in Chapter 6.0. Since the Silver Line bus will be running underground, only its surface route will affect traffic. Traffic analyses in this report will mainly focus on impacts of the Silver Line services around the proposed portal locations at NEMC portal and Columbus Avenue, since this is where changes in traffic would occur with Silver Line Phase III operations, depending on the alternative selected.

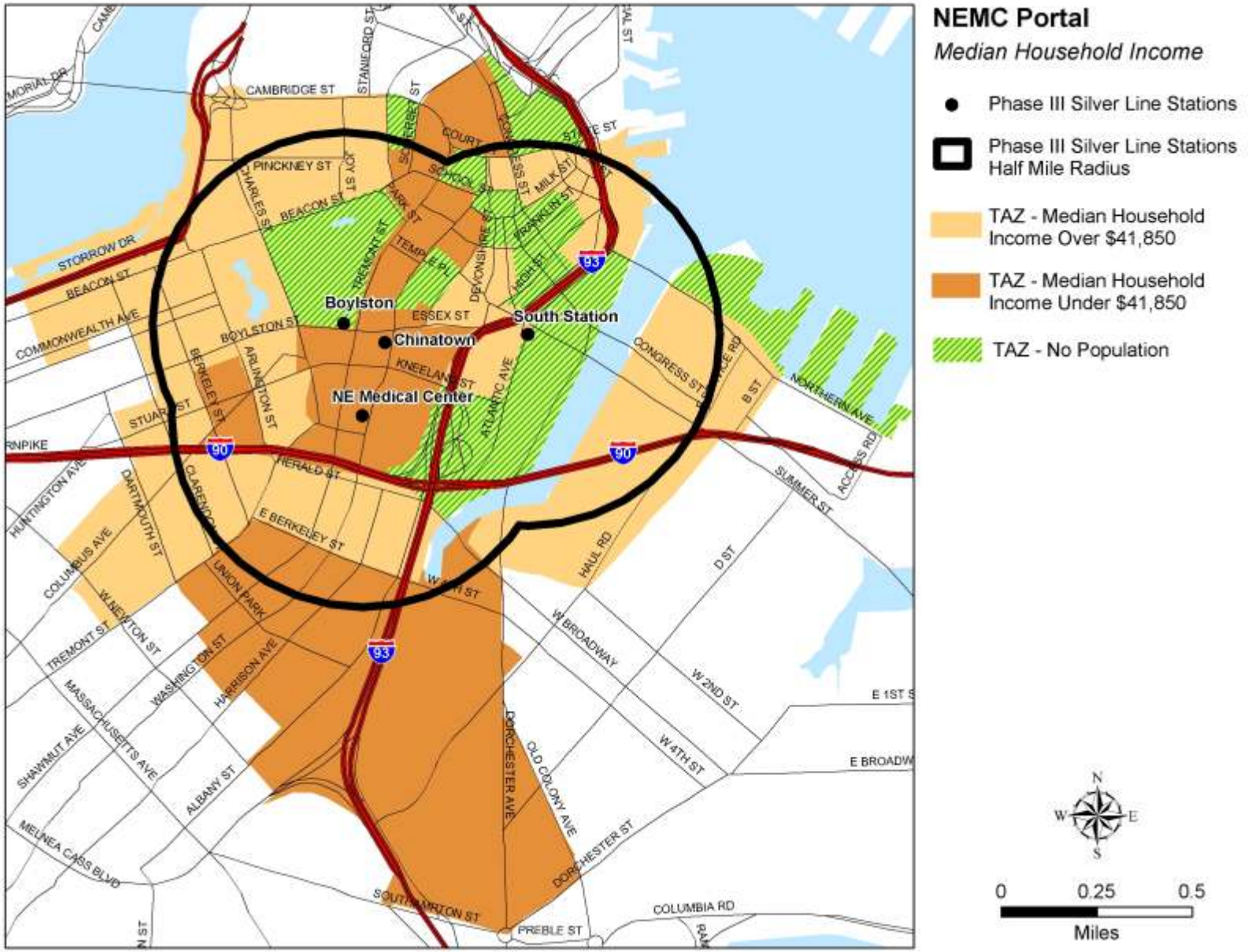


Figure 4.3-1
NEMC Portal
Median Household Income

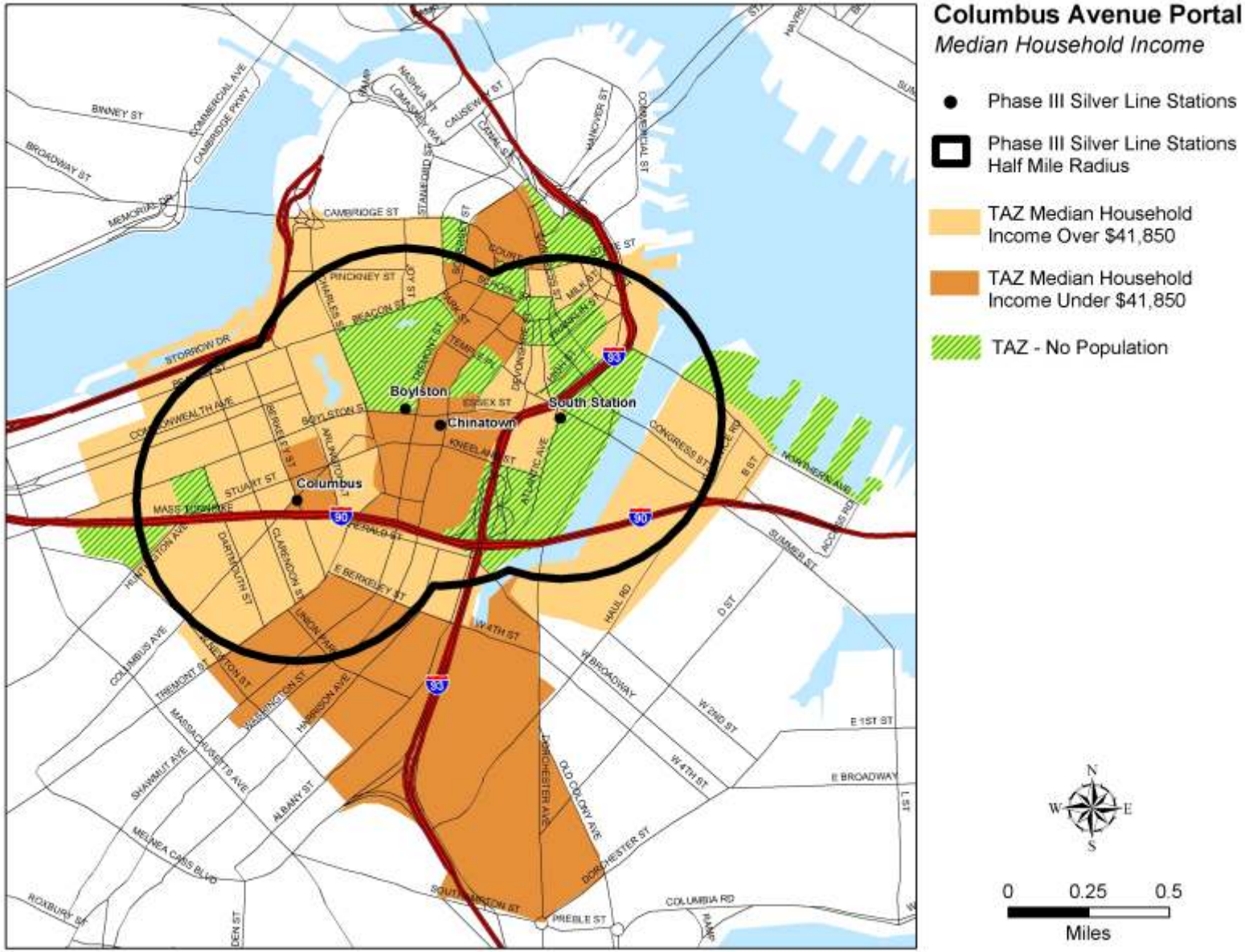


Figure 4.3-2
Columbus Avenue Portal
Median Household Income

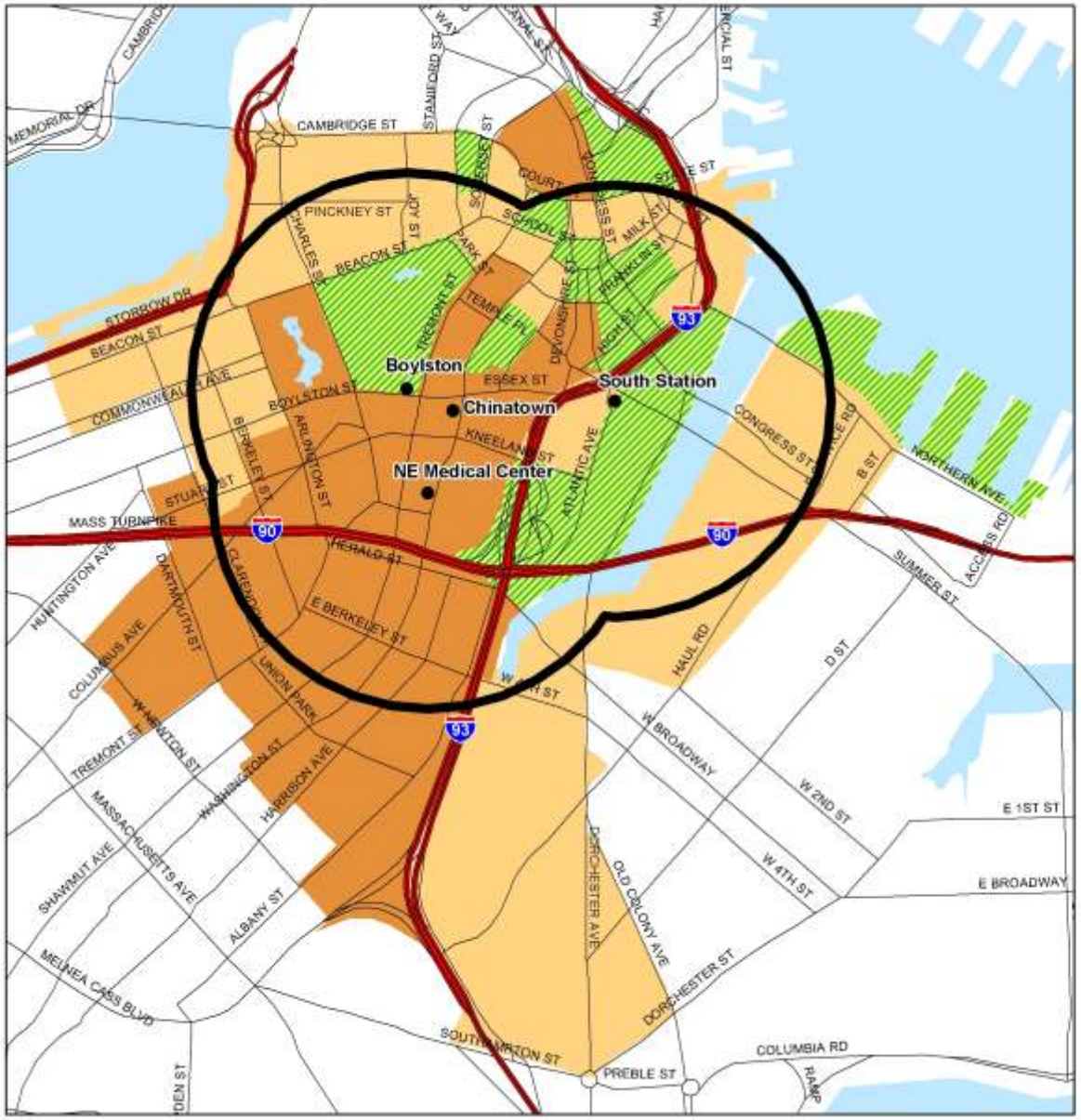
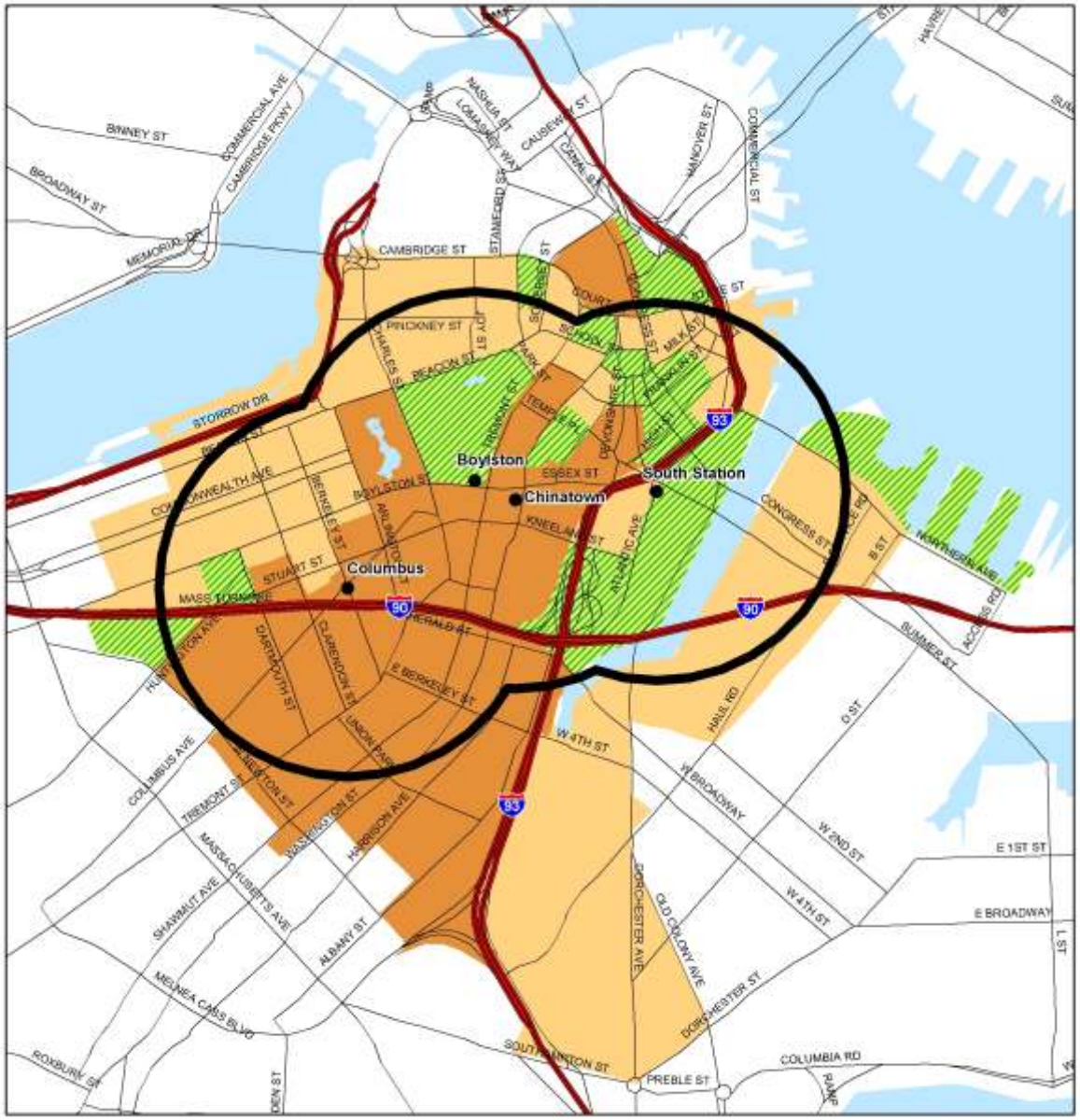


Figure 4.3-3
NEMC Portal
Minority Population



Columbus Avenue Portal

Minority Population

- Phase III Silver Line Stations
- Phase III Silver Line Stations Half Mile Radius
- TAZ - Minority Population Under 21.4%
- TAZ - Minority Population Over 21.4%
- TAZ - No Population

N W E S

0 0.25 0.5

Miles

Figure 4.3-4
Columbus Avenue Portal
Minority Population

All traffic analyses were developed using methodologies described in the 2000 Highway Capacity Manual (HCM 2000). The analyses were performed utilizing the Synchro Software Program, Version 5, developed by Trafficware. Synchro 5 is a complete software package for modeling and evaluating the effects of signal timings for closely spaced intersections.

Level of Service (LOS) is an index of the quality of traffic flow for roadway facilities such as highways, arterials, and intersections. As defined in HCM 2000, these levels of service are assigned letter grades from A to F. LOS A indicates that traffic is operating with little or no vehicle delay, LOS E indicates that a facility is operating at capacity, and LOS F indicates congestion and long delays. Levels of service B, C, and D are indicative of intermediate conditions. Levels of service A through D are generally considered acceptable in urban areas such as the Silver Line Phase III study area.

The LOS of all intersections is defined in terms of the average delay experienced per vehicle. Signalized intersections are designed to carry more vehicles and reduce vehicle conflict. A driver's wait for 30 seconds at a red signal is more "comfortable" than a 30 seconds wait at a stop sign during which time a driver must constantly watch for an unacceptable gap in opposing traffic. Therefore, the LOS criteria for signalized and unsignalized intersections are different to account for a driver's response to the delay. The criteria for signalized and unsignalized intersections are shown in Table 4.4-1.

Data collection for this analysis has been coordinated with the Boston Transportation Department (BTD). This consists of traffic data extrapolated from previous studies, obtained from BTD, conducted on intersections within the vicinity of the proposed portal locations as well as updated 2004 traffic counts conducted by the MBTA. Traffic projections in the Chinatown Parcel C Redevelopment Environmental Notification Form (April 17, 2001) were utilized for the NEMC portal area. Traffic projections from the Clarendon Project Draft Impact Report (June 30, 2004), currently under review at the Boston Redevelopment Authority, and the Columbus Center Final Environmental Impact Report/Final Impact Report (May, 15, 2003) were used for the Columbus Avenue Alternative.

Table 4.4-1 – Level of Service Delay Thresholds for Intersections

Level of Service	Signalized Intersection Average Vehicle Delay (Seconds)	Unsignalized Intersection Average Vehicle Delay (Seconds)
A	Less than or equal 10.0	Less than or equal 10
B	Between 10.1 and 20.0	Between 10.1 and 15.0
C	Between 20.1 and 35.0	Between 15.1 and 25.0
D	Between 35.1 and 55.0	Between 25.1 and 35.0
E	Between 55.1 and 80.0	Between 35.1 and 50.0
F	Greater than 80.0	Greater than 50.0

4.4.2 New England Medical Center Portal Area

The New England Medical Center (NEMC) Portal is located within the Washington Street corridor. The main generators of transportation trips in the portal vicinity are:

- The New England Medical Center, located on the east side of Washington Street opposite the portal location, has an ambulance entrance on Nassau Street;

- The Doubletree Hotel, located on the west side of Washington Street, next to the portal location;
- The Metropolitan, a 251-unit mixed-use development located at Chinatown Parcel C on Nassau Street, which opened in the summer of 2004;
- The YMCA at the northwest corner of the intersection of Washington Street and Oak Street;
- The Josiah Quincy School at the southwest corner of in the intersection of Washington Street and Oak Street;
- A residential building opposite the Quincy school, at the southeast corner of the intersection of Washington Street and Oak Street.

4.4.2.1 Roadways

The following describes the roadways within the NEMC portal area. See Figure 4.4-1 for additional information.

Washington Street is a major arterial, running from Hyde Park in the south to Downtown Crossing in the north. Washington Street is a two-way road, close to the portal area, consisting of two 11-foot lanes in each direction. A median divides the direction of travel and sidewalks are in good condition on both sides of the street.

Nassau Street connects Washington Street to Harrison Avenue. The NEMC ambulance entrance is located on this street with a dedicated lane in and out for emergency vehicles. A valet entrance for NEMC is also located on this street.

Oak Street extends from Tremont Street in the west to Hudson Street in the east. Between Tremont Street and Washington Street, Oak Street is a two-way street with daytime 15 minute parking allowed on the north side for pickup/drop off at the YMCA. Between Washington Street and Harrison Avenue, it becomes a one-way street with one eastbound travel lane, with resident parking on the south side of the street. Sidewalks are in good condition on both sides of the street.

Marginal Road extends from Harrison Avenue in the east to Berkeley Street in the west. It is a one-way street with two 13-foot westbound travel lanes. Parking is permitted on both sides of Marginal Road and sidewalks are in fair condition on both sides.

Kneeland Street/Stuart Street extends from Atlantic Avenue in the east to Washington Street in the west where it changes to Stuart Street. Kneeland Street (and Stuart Street from Washington Street to Charles Street) is a two-way street with two travel lanes in each direction and parking allowed on both sides.

Herald Street is an east-west urban principal arterial that runs from Arlington Street to Albany Street, connecting to I-93. Herald Street is one-way eastbound except for the block between Washington Street and Harrison Avenue, which has an added single westbound lane. No on-street parking is allowed in the vicinity of Washington Street. Sidewalks are generally provided on the south side only.

4.4.2.2 Intersections Studied

The following intersections were analyzed for existing (2004) conditions:

- Washington Street and Kneeland Street/Stuart Street (signalized)
- Washington Street and Nassau Street/Doubletree Hotel Entrance/Exit (unsignalized)
- Washington Street and Oak Street (signalized)
- Washington Street and Marginal Road (signalized)
- Washington Street and Herald Street (signalized)

Washington Street and Kneeland Street/Stuart Street

This is a four-legged signalized intersection. The northbound approach on Washington Street has two through-lanes - one is shared with right-turn and the other with left-turn. North of Kneeland Street, Washington Street is a one-way northbound street to Downtown Crossing with two travel lanes. The westbound approach on Kneeland Street has one through-lane shared with left-turn, one through-lane shared with right-turn and one middle through-lane. The eastbound approach on Stuart Street has one through-lane shared with left-turn and one through-lane shared with right-turn. The traffic signal at this intersection has an exclusive pedestrian phase and crosswalks are provided at all four approaches.

Washington Street and Nassau Street / Doubletree Hotel Entrance

This is an unsignalized intersection with three approaches and one driveway to the Double Tree Hotel. Both the sounthbound and northbound approaches on Washington Street have two through-lanes - one is shared with right-turn and the other with left-turn. Nassau Street has two separate one-lane entrances - the north side entrance is dedicated to emergency vehicles and the south side entrance is used for valet parking. The driveway to the Doubletree Hotel is used for both entering and exiting the hotel parking area. The median on Washington Street is open at this intersection allowing for left-turn movements for all approaches. There is a crosswalk on Nassau Street.

Washington Street and Oak Street

This is a four-legged signalized intersection. Both the southbound and northbound approaches on Washington Street have two through-lanes - one is shared with right-turn and the other with left-turn. Oak Street is a two-way street between Washington Street and Tremont Street and is one-way east of Washington Street with one eastbound travel lane. This approach has one through-lane with left-turn and right-turn shared movements. The traffic signal at this intersection has an exclusive pedestrian phase and crosswalks are provided at all four legs.

Washington Street and Marginal Road

This is a four-legged signalized intersection. The southbound approach on Washington Street has one through-lane dedicated to MBTA buses and one right-turn lane for general traffic. The northbound approach on Washington Street has one left-turn only lane and two through-lanes – one of which is shared with a left-turn. The opposite lane is one counter flow bus only southbound lane. Marginal Road is a one-way westbound roadway. The westbound approach on Marginal Road has two lanes - one for through movement and the other for through movement shared with a right-turn. The traffic signal at this intersection has an exclusive pedestrian phase and crosswalks are provided at all sides except for the south leg of Washington Street.

Washington Street and Herald Street

This is a four-legged signalized intersection. The southbound approach on Washington Street has one through-lane dedicated the MBTA buses. The northbound approach on Washington Street has two through-lanes and one right-turn only lane. Herald Street is a one-way westbound roadway to the east of Washington Street. The westbound approach on Hearld Street has two through-lanes and one left-turn only lane. The east leg of the intersection is two way with one right-turn lane approach westbound. The three-phase signal allows for concurrent pedestrian movements. Crosswalks are provided at all sides except for the north leg of Washington Street.

4.4.2.3 Traffic Analysis

Table 4.4-2 and Table 4.4-3 summarize the 2004 Existing Conditions LOS analyses results at the unsignalized and signalized intersections within the Washington Street corridor, respectively. The LOS is presented on Figure 4.4-1 for both the morning [7:00-9:00 AM] and evening [4:00 – 6:00 PM] peak hour periods.

Table 4.4-2 – 2004 Existing Conditions Unsignalized Intersection LOS Analysis Results for the NEMC Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Washington St. and Nassau St./ Doubletree Hotel Entrance/Exit						
Washington St. Northbound, Left Turn	0.01	8.1	A	0.01	8.2	A
Washington St. Southbound, Left Turn	0.04	9.2	A	0.02	8.7	A
Nassau Street	0.02	14.7	B	0.01	13.2	B
Doubletree Hotel Entrance/Exit	0.02	13.1	B	0.01	14.4	B

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle for a particular movement (s) in seconds.
LOS = Level of Service.

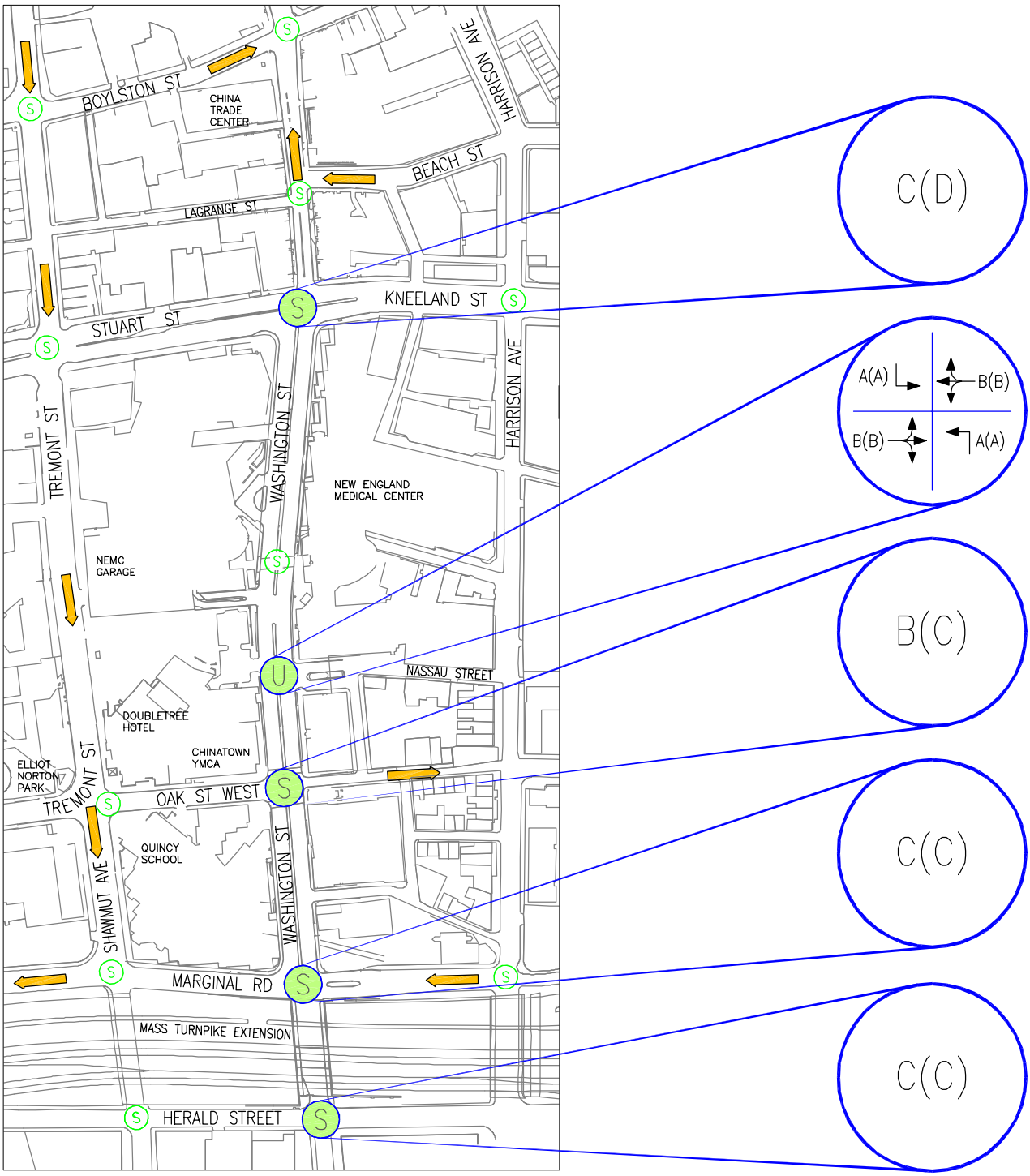
The only unsignalized intersection along Washington Street in the NEMC portal area operates at an acceptable LOS (D or better) under 2004 Existing Conditions during the morning and evening peak hours. The longest delay occurs at the Nassau Street approach. Both Washington Street approaches operate at LOS A, while the Nassau Street and Doubletree Hotel approaches operate at LOS B.

As shown above, all four signalized intersections analyzed in the 2004 Existing Conditions operate at an overall acceptable condition during the morning peak hour. However, the evening peak hour for Washington Street and Kneeland Street intersection operates with congestion. The LOS analyses results indicate that vehicles at the Washington Street and Kneeland Street intersection experience the longest average stopped delays, compared to the other three intersections analyzed. This intersection operates at LOS E during the evening peak hour, while the other three intersections operate at acceptable conditions (LOS C).

4.4.2.4 Traffic Accident History

The most current traffic accident data from 2000 through 2002 was obtained from Massachusetts Highway Department (MHD) and is presented in Table 4.4-4 below. The data was only analyzed for the section of the proposed NEMC Portal along Washington Street between Stuart Street/Kneeland Street and Herald Street.

As shown above, the intersection with the highest accident rate is Washington Street and Kneeland Street/Stuart Street with 26 total accidents for the three years. However, there was a drop in accidents during 2002. The only unsignalized intersection, Washington Street and Nassau Street, had the least amount of accidents, with two occurring in 2001.



LEGEND

LEVEL OF SERVICE
C(C): LOS AM PEAK (LOS PM PEAK)

- STUDY INTERSECTION – SIGNALIZED
- STUDY INTERSECTION – UNSIGNALIZED
- SIGNALIZED INTERSECTION
- EXISTING ONE WAY STREET

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.4-1
Existing Level of Service at Study Intersections - NEMC Portal

Table 4.4-3 – 2004 Existing Conditions Signalized Intersection LOS Analysis Results for the NEMC Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Washington St. and Kneeland St./Stuart St.		31.8	C		**57.7**	**E**
Eastbound, Left	0.76	49.9	D	0.44	25.8	C
Eastbound, Thru	0.87	33.9	C	**1.14**	**98.8**	**F**
Westbound, Left	0.56	17.4	B	0.58	20.9	C
Westbound, Thru	0.64	18.7	B	0.41	17.1	B
Northbound, Thru	0.89	46.4	D	0.73	30.3	C
Washington St. and Oak St.		10.3	B		20.8	C
Eastbound, Thru	0.73	29.3	C	0.89	41.7	D
Northbound, Thru	0.58	6.3	A	0.42	10.1	B
Southbound, Thru	0.15	4.5	A	0.25	15.1	B
Washington St. and Marginal Road		20.9	C		26.8	C
Westbound, Thru	0.24	23.5	C	0.30	33.7	C
Northbound, Left	0.53	17.7	B	0.33	15.8	B
Northbound, Thru	0.53	17.4	B	0.33	15.4	B
Southbound, Thru	0.28	35.0	C	0.37	53.4	D
Southbound, Right	0.76	52.3	D	**0.96**	**102**	**F**
Washington St. and Herald St.		33.7	C		24.2	C
Eastbound, Left	0.36	32.8	C	0.44	43.3	D
Eastbound, Thru	0.55	16.5	B	0.80	24.6	C
Westbound, Right	**1.07**	**82.7**	**F**	0.82	31.5	C
Northbound, Thru	0.37	15.2	B	0.26	16.4	B
Northbound, Right	0.04	14.8	B	0.08	17	B
Southbound, Thru	0.05	0	A	0.05	0	A

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

Table 4.4-4 – Traffic Accident Data Summary for the NEMC Portal Study Area, 2000 to 2002

Intersection	2000	2001	2002	Total
Washington St. and Kneeland St. and Stuart St.	12	11	3	***26***
Washington St. and Nassau St./Doubletree Hotel Entrance/Exit	0	2	0	***2***
Washington St. and Oak St.	4	4	2	***10***
Washington St./Marginal Rd..	4	4	1	***9***
Washington St./Herald St.	5	9	5	***19***

4.4.2.5 Parking

An inventory of on-street parking displays a variety of restrictions to parking along Washington Street. There are 36 metered parking spaces (two hour limit) along Washington Street between Oak Street West and Stuart Street. There are six residential permit parking spaces along Washington Street (east side) between Pine Street and Oak Street. Other on-street uses in the NEMC vicinity include bus stops, cab stands, patient pick-up/drop-off, and handicapped spaces. There is valet parking (two spaces) in front of the Doubletree Hotel (west side).

The following parking lots and garages located around the Washington Street portal area provide off-street parking:

- The NEMC Garage, 930 spaces.
- The Auto Parks, 80 spaces (located behind the Doubletree Hotel with access from Tremont Street).
- The Parcel C garage, 283 spaces (opened in 2004).

4.4.2.6 Loading and Service

There is a loading zone for NEMC that occupies one parking space along Washington Street northbound between Nassau Street and Kneeland Street.

4.4.2.7 Emergency Vehicles

The emergency vehicle entrance to the New England Medical Center is located on Nassau Street. Emergency vehicles (ambulances) use a dedicated two-way lane on Nassau Street for in and out movements. Only emergency vehicles are allowed to exit from Nassau Street into Washington Street. Other vehicles can enter Nassau Street from Washington Street using a separate one-way lane. As previously stated, the intersection is unsignalized and therefore has no emergency pre-emptive signal control for left-turn movements onto Washington Street southbound.

4.4.3 Columbus Avenue Portal Area

Similar to Washington Street within the NEMC portal area, the Columbus Avenue portal area is a heavily utilized section of downtown Boston. A dense network of one-way streets and closely spaced signalized intersections support the highly developed urban land uses. In the portal vicinity, the main generators of transportation trips are:

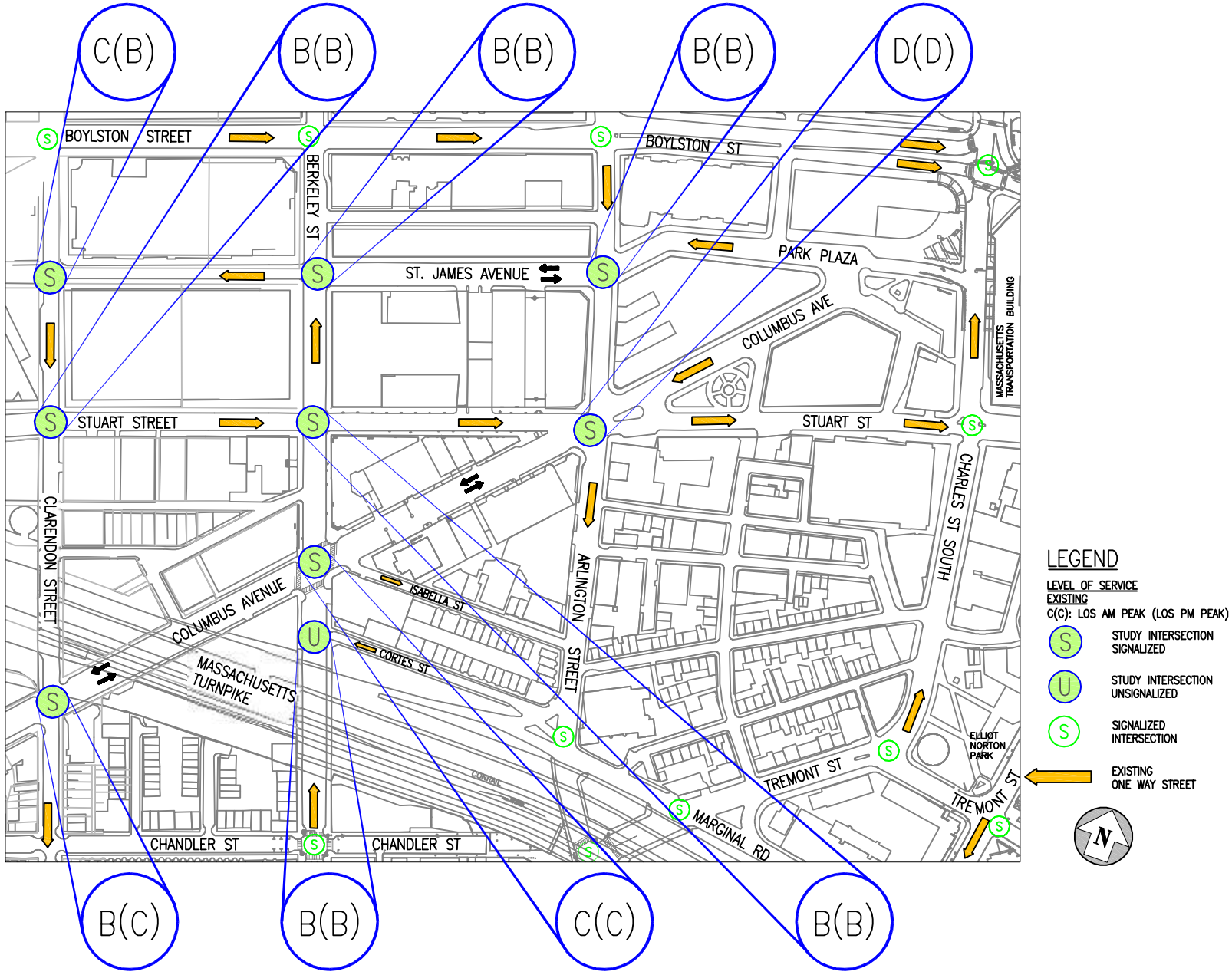
- Downtown offices, hotels and supporting commercial uses;
- The Salvation Army headquarters at the corner of Columbus Avenue and Berkeley Street;
- A fire station along the south side of Columbus Avenue between Berkeley Street and Arlington Street; and
- A restaurant, hotel, and a school located at the corner of Columbus Avenue and Arlington Street.

4.4.3.1 Roadways

The following describes the roadways within the Columbus Avenue portal area. See Figure 4.4-2 for additional information.

Columbus Avenue is classified as an urban principal arterial that runs in an east-west direction beginning near the Public Garden at Park Plaza and continuing through Lower Roxbury to Franklin Park. In the vicinity of the portal, Columbus Avenue consists of two westbound lanes and two eastbound lanes with traffic flow separated by a flush, five-foot median. Parking meters and sidewalks are provided on each side of the street.

Stuart Street is an east-west urban principal arterial that runs from Huntington Avenue to Washington Street, where it becomes Kneeland Street. Stuart Street is one-way eastbound with two travel lanes within the portal area (Stuart Street is two-way east of Charles Street). Metered parking and sidewalks are provided on both sides of the street. No on-street parking is allowed within the vicinity of the Hancock Tower (Trinity Place to Clarendon Street).



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.4-2
Existing Level of Service at Study Intersections - Columbus Portal

St James Avenue is an urban principal arterial that runs from Arlington Street to Dartmouth Street. St. James Avenue is two-way, with one eastbound lane and two westbound lanes between Arlington Street and Berkeley Street. St. James Avenue runs one-way westbound with three travel lanes between Berkeley Street and Dartmouth Street. Metered parking is available on both sides of the street between Berkeley and Arlington Streets, however, no parking is provided between Berkeley and Dartmouth Streets. Sidewalks are provided on both sides of the street.

Arlington Street is an urban principal arterial that runs southbound from Beacon Street to Marginal Road/Mass. Pike where it becomes Herald Street. Arlington Street is a four lane one-way street until Stuart Street where traffic becomes three lanes plus one dedicated school pick-up and drop-off lane during school hours. Sidewalks are provided on both sides. Parking is not allowed between Boylston and Stuart Streets.

Berkeley Street is classified by MHD as an urban principal arterial. It runs one-way northbound from East Berkeley Street in the South End, across the Massachusetts Turnpike (I-90), to the Back Bay. Based on an Automatic Traffic Recorder (ATR) count in February 2002, Berkeley Street carries approximately 12,000 vehicles per day across the Turnpike Bridge. Three travel lanes, metered parking, and sidewalks on both sides of the street are provided within the vicinity of the portal area.

Clarendon Street is classified as an urban minor arterial that runs one-way southbound from the Back Bay to the South End. The roadway is approximately 35 feet wide and consists of two travel lanes. Metered parking is provided on the east side of the street except within the vicinity of the Hancock Tower (St. James Avenue to Stuart Street). No parking is allowed at the meters on weekdays from 7:00 to 9:30 AM and from 4:00 to 6:00 PM. Residential parking is provided on both sides of the street south of Columbus Avenue. Sidewalks are provided on both sides of the street.

Park Plaza is an urban roadway that runs one-way westbound from Charles Street to Arlington Street where it becomes St. James Street. Park Plaza is a two-lane street with on-street parking and sidewalks provided on both sides.

Cortes Street is a local one-way street westbound, one block long, running from Arlington Street to Berkeley Street, adjacent to the Massachusetts Turnpike. Residential parking is provided on the north side of the street serving the adjacent housing.

Isabella Street is a local one-way street eastbound, one block long, running from Columbus Avenue to Arlington Street. Residential parking is provided on the south side of the street serving the adjacent housing.

4.4.3.2 Intersections Studied

The following intersections were analyzed for the existing 2004 conditions:

- Arlington Street/Park Plaza/St. James Avenue (Signalized)
- Arlington Street/Columbus Avenue/Stuart Street (Signalized)
- Berkeley Street/Cortes Street (Unsignalized)
- Berkeley Street/St. James Avenue (Signalized)
- Berkeley Street/Stuart Street (Signalized)
- Berkeley Street/Columbus Avenue (Signalized)
- Clarendon Street/Columbus Avenue (Signalized)
- Clarendon Street/Stuart Street (Signalized)
- Clarendon Street/St. James Street (Signalized)

The roadways and intersections identified above are in proximity to the proposed portal area and could be affected by the Columbus Avenue Alternative. The Columbus Avenue Alternative would add a maximum of 12 Silver Line Phase III vehicles per hour in each direction to the local roadway traffic (beyond the Columbus Avenue/Berkeley Street intersection). Since this represents a small percentage of the total traffic, no other intersections outside the study area were analyzed.

Arlington Street/Park Plaza/St. James Avenue is a four-legged, three-phase, signalized intersection with approaches from Arlington Street southbound, and Park Plaza westbound. The Arlington Street southbound approach is four lanes, with the right lane functioning as a combined through/right turn lane. The Park Plaza westbound approach is three lanes, with the left lane functioning as a left-turn only lane. (The right lane approach is generally not utilized due to off-peak valet parking and commercial uses, and allowed on-street parking approximately 100 feet prior to the intersection.) Pedestrian crosswalks exist across all four intersection legs and an exclusive pedestrian signal phase is provided.

Arlington Street/Columbus Avenue/Stuart Street is a six-legged, multi-phase, signalized intersection with approaches from Arlington Street southbound, Stuart Street eastbound and Columbus Avenue eastbound and westbound. The Arlington Street southbound approach is four lanes, with the left lane functioning as left-turn only and the right as a combined through/right turn lane. The Stuart Street and Columbus Avenue eastbound approaches are each two lanes, with the right as a combined through/right lane. The Columbus Avenue southwest-bound approach is also two lanes, with the left lane functioning as a left-turn only. Pedestrian crosswalks exist across all intersection approach and departure lanes and an exclusive pedestrian signal phase is provided.

Arlington Street/Cortes Street is an intersection outside the area of analysis, adjacent to the signalized intersection of Arlington Street/Marginal Road and the Massachusetts Turnpike westbound on-ramp. The Arlington Street approach is three through-lanes with an additional channelized right turn lane onto the Masspike or Cortes Street that is signalized. Currently vehicles can also enter Cortes Street westbound via a channelized lane from the Marginal Road intersection. BTD currently has plans to eliminate this traffic movement.

Berkeley Street/Cortes Street is an unsignalized T-intersection. The Berkeley Street westbound approach is three through travel lanes while the Cortes Street approach is stop controlled, with a right turn only.

Berkeley Street/St. James Avenue is a four-way, signalized intersection with two approaches. Berkeley Street is one-way northbound with three travel lanes - one shared left-turn/through-lane, one through-lane, and one shared through/right-turn lane. St. James Avenue is two-way east of Berkeley Street and one-way westbound to the west of Berkeley Street. The St. James Avenue westbound approach is two travel lanes - one through-lane and one shared through/right-turn lane. There is metered parking on each side of the street for both approaches. The traffic signal operates in two phases - Berkeley Street northbound and St. James Avenue westbound; an exclusive pedestrian phase is activated by pedestrian pushbutton.

Berkeley Street/Stuart Street is a four-way, signalized intersection with a northbound approach on Berkeley Street and an eastbound approach on Stuart Street. The traffic signal at this intersection is two phases, with a third phase exclusively for pedestrians provided on demand by pushbutton actuation. The northbound approach on Berkeley Street is three travel lanes - two through-lanes and one shared through/right-turn lane. The eastbound approach on Stuart Street is two travel lanes. There is a metered parking on each side of the street for both approaches. .

Berkeley Street/Columbus Avenue is a three-phase, signalized intersection with three approaches. The signal phasing provides a leading phase to Columbus Avenue eastbound. Berkeley Street is one-way northbound with three travel lanes. Columbus Avenue is four lanes,

two lanes in each direction. Northeast-bound and southwest-bound lanes on Columbus Avenue are separated by a flush, five-foot median. Parking is provided on both sides of Berkeley Street and Columbus Avenue. Isabella Street intersects Columbus Avenue immediately to the east and allows for free-flow right turn movements onto the one-way street.

Clarendon Street/Columbus Avenue is a four-way, signalized intersection with three approaches - Clarendon Street southbound, Columbus Avenue northeast-bound, and Columbus Avenue southeast-bound. The Clarendon Street southbound approach consists of three travel lanes - one shared through/right-turn lane, one through-lane, and one left-turn only lane. The Columbus Avenue northeast-bound approach is striped as two travel lanes, although one lane is a metered parking lane, effectively making it a one-lane approach. The Columbus Avenue southwest-bound approach comprises two travel lanes (one shared left-turn/through-lane and one through-lane). The signal has two phases with an exclusive pedestrian phase actuated by pushbutton.

Clarendon Street/Stuart Street is a four-way, two-phase, signalized intersection. The Stuart Street eastbound approach is three travel lanes - two through-lanes and a right-turn only lane. The Clarendon Street southbound approach is two travel lanes - one through-lane and one shared left-turn/through-lane. No parking is allowed on either side of the street on either approach. An exclusive pedestrian phase is activated by pushbutton.

Clarendon Street/St. James Avenue is a four-way, signalized intersection with two approaches - St. James Avenue westbound and Clarendon Street southbound. The signal operates in two phases with an exclusive pedestrian phase actuated by pushbutton. The St. James Avenue westbound approach comprises three travel lanes - two through-lanes and one left-turn only lane. Clarendon Street southbound consists of three travel lanes - two through-lanes and one shared through/right-turn lane. No on-street parking is allowed on S. James Avenue but time-restricted metered parking lanes are provided on the Clarendon Street approaches.

4.4.3.3 Traffic analysis

Tables 4.4-5 and 4.4-6 summarize the 2004 Existing Conditions LOS analyses results at the unsignalized and signalized intersections, respectively. The LOS is presented in Figure 4.4-2 for both the morning 7:00-9:00 AM and evening 4:00-6:00 PM peak hour periods.

Table 4.4-5 – 2004 Existing Conditions Unsignalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Berkeley Street/Cortes Street Westbound, Right	0.15	10.2	B	0.25	10.7	B

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle for a particular movement(s) in seconds.
LOS = Level of Service.

As shown above, the Berkeley Street/Cortes Street intersection operates at an acceptable LOS for westbound right turns onto Berkeley Street during the morning and evening peak hours.

As shown below, a majority of the signalized intersections analyzed in the 2004 Existing Conditions for the Columbus Avenue portal operate at overall LOS C or better conditions. The

intersection of Arlington Street/Stuart Street/Columbus Avenue operates with congestion at overall LOS D during the morning and evening peak hours.

Table 4.4-6 – 2004 Existing Conditions Signalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Arlington St/ Park Plaza/ St. James Ave		12.7	B		14.2	B
Eastbound, Right	0.16	47.7	D	0.36	22.5	C
Westbound, Left/Thru	0.77	36.4	D	0.79	34.3	C
Southbound, Thru/Right	0.33	3.20	A	0.34	4.40	A
Arlington St/ Columbus Ave/ Stuart St		38.9	D		47.3	D
Eastbound, Thru/Right	0.88	42.9	D	**0.93**	**56.4**	**E**
Southbound, Left	0.85	54.7	D	0.76	35.6	D
Southbound, Thru/Right	0.72	29.6	C	0.81	32.8	C
Northeast bound, Thru/Right	0.86	42.4	D	**1.09**	**90.7**	**F**
Southwest bound, Left	0.19	29.4	C	0.29	29.5	C
Southwest bound, Thru	0.37	30.9	C	0.42	30.7	C
Berkeley St/ St. James Ave		12.7	B		13.7	B
Westbound, Thru/Right	0.39	18.6	B	0.68	23.1	C
Northbound	0.64	9.7	A	0.64	8.6	A
Berkeley St/ Stuart St		19.2	B		14.7	B
Eastbound, Left/Thru	0.55	21.9	C	0.66	17.4	B
Northbound, Thru/Right	0.82	16.3	B	0.69	12.1	B
Berkeley St/ Columbus Ave		23.9	C		22.7	C
Northbound	0.87	33.4	C	0.86	33.1	C
Northeast bound, Left/Thru	0.42	14.6	B	0.46	9.9	A
Southwest bound, Thru/Right	0.16	6.2	A	0.25	12.0	B
Clarendon St/ Columbus Ave		17.0	B		31.4	C
Southbound, Left	0.42	17.6	B	0.62	43.3	D
Southbound, Thru/Right	0.53	18.0	B	0.82	46.2	D
Northeast bound, Thru/Right	0.39	15.0	B	0.38	14.9	B
Southwest bound, Left/Thru	0.27	17.5	B	0.40	15.1	B
Clarendon St/ Stuart St		15.6	B		16.2	B
Eastbound, Thru/Right	0.48	18.6	B	0.44	16.4	B
Southbound, Left/Thru	0.71	12.0	B	0.69	17.3	B
Clarendon St/ St. James Ave		22.3	C		12.6	B
Westbound, Left/Thru	0.36	15.2	B	0.38	6.9	A
Southbound, Thru/Right	0.67	27.6	C	0.86	20.8	C

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

4.4.3.4 Traffic Accident History

The most current traffic accident data from 2000 through 2002 for the Columbus portal area intersections was obtained from Massachusetts Highway Department (MHD) and is presented in Table 4.4-7 below.

Table 4.4-7 – Traffic Accident Data Summary for the Columbus Avenue Portal Area - 2000 to 2002

Intersection	2000	2001	2002	Total
Arlington St./St. James Ave./Park Plaza	4	2	0	***6***
Arlington St./ Stuart St./ Columbus Ave.	12	14	6	***32***
Berkeley St./Cortes St.	1	0	0	***1***
Berkeley St./ St. James Ave.	6	4	1	***11***
Berkeley St./ Stuart St.	5	10	1	***16***
Berkeley St./ Columbus Ave.	4	8	5	***17***
Clarendon St./ Columbus Ave.	2	2	2	***6***
Clarendon St./ Stuart St.	4	4	1	***9***
Clarendon St./ St. James Ave	2	6	2	***10***

According to the traffic accident data from MHD, the most dangerous intersection is Arlington Street/Stuart Street/Columbus Avenue with 32 accidents occurring within the three year period. This accident rate is almost double the second highest accident rate of 17 at the intersection of Berkeley St. and Columbus Avenue. One accident occurred at Berkeley Street and Cortes Street which is the only unsignalized intersection. Widening the travel lanes, adjusting the signal phasing and timing, improving the approach signage and adding left-turn lanes are ways to help reduce accidents.

4.4.3.5 Parking

On-street parking is generally provided on the following streets within the vicinity of the Columbus Avenue portal:

- Columbus Avenue – both sides from Arlington Street to Clarendon Street;
- Park Plaza – both sides from Columbus Avenue to Arlington Street;
- St. James Avenue – both sides from Arlington Street to Berkeley Street; and
- Clarendon Street – east side only from Stuart Street to Columbus Avenue.

Table 4.4-8 lists the parking lots and garages located in the vicinity of the portal.

Table 4.4-8 – Off-Street Parking in the Study Area

Facility	Capacity (spaces)
Surface Lots	
Stanhope/Clarendon	52
A & C Parking (westside)	35*
Columbus/Berkeley (eastside)	52
Arlington/Melrose	70
Parking Garages	
Back Bay Garage (off Boylston & St. James	625
10 St. James (off St. James & Stuart Street	170
John Hancock Garage (off Clarendon Street	774

* Will be relocated to Parcel 18 as part of the Columbus Center Project.

4.4.3.6 Loading and Service

There is a Loading Zone which occupies two parking spaces along Columbus Avenue between Arlington Street and Berkeley Street. There is also a loading dock at Benjamin Franklin Smith Printers on Columbus Avenue. Additional Loading Zones are located on both sides of St. James Avenue between Clarendon Street and Arlington Street.

4.4.3.7 Emergency Vehicles

The District 4 Fire Station is located on the south side of Columbus Avenue, east of Berkeley Street. A driveway on Columbus Avenue provides access to the station. The station houses three vehicles; a ladder truck, a pumper truck, and a rescue/ambulance vehicle. Traffic signals (fire pre-empt) are located directly in front of the station and in the immediate vicinity of the proposed portal.

4.4.4 2004 Existing Conditions Summary

The analysis presented above indicates that all intersections within the study area operate at acceptable conditions during the morning peak hour. Most intersections within the study area operate at acceptable conditions during the evening peak hour, with the exception of the Washington Street and Kneeland Street intersection which operates with congestion. The LOS analyses results indicate that vehicles at the Washington Street and Kneeland Street intersection experience the longest average stopped delays (LOS E). The intersection of Arlington Street/Stuart Street/Columbus Avenue operates at acceptable conditions but experiences congestion (LOS D) during both the morning and evening peak hours.

4.5 Transit Pedestrian and Bicycle

The dense urban environment of the Silver Line Phase III Build Alternatives contains numerous public transportation options and substantial pedestrian activity within the study area. Rapid transit lines within the study area include the Green, Orange and Red Lines. The Green Line currently has downtown stops at Arlington and Boylston. The Red Line stops at Park Street and South Station. The Orange Line stops at New England Medical Center and Chinatown. Although there are no official bike lanes, some study area roadways are designated as bicycle routes and the City of Boston has installed bicycle facilities.

Table 4.5-1 describes the existing peak hour pedestrian volumes and levels of service (LOS) for intersections near the existing Chinatown and Boylston stations. Pedestrian volumes around these stations were analyzed because they are locations proposed for future Silver Line Phase III stations. The LOS for all locations is A, indicating that there is sufficient sidewalk space to handle the existing flow of pedestrians in these high-traffic areas. Detailed backup for all pedestrian analyses are included in Technical Appendix D.

Table 4.5.-1 – Existing Chinatown and Boylston Station Pedestrian Volumes and LOS

Location	No-Build	
	Peak Hour	LOS
Boylston St./Essex St./Washington St. [1]	**7:45 AM – 8:45 AM**	
Washington South (West Side)	609	A
Washington South (East Side)	834	A
Boylston St/Tremont St. [2]	**5:00 PM – 6:00 PM**	
Tremont St South	786	A
Tremont St North	890	A
Boylston St West	724	A
Boylston St East	978	A
Boylston St/Charles St [2]	**5:00 PM – 6:00 PM**	
Charles St South	532	A
Charles St North	639	A
Boylston St West	309	A
Boylston St East	209	A

Notes:
1. 2001 pedestrian counts from the Liberty Place Draft Project Impact Report, December 2001, were inflated by 2% annually.
2. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, September 2004.

4.5.1 New England Medical Center Portal Area

4.5.1.1 Transit

The Orange Line New England Medical Center Station is located on Washington Street opposite the NEMC main entrance. In addition to the Orange Line, a number of bus routes including the Silver Line Phase I Bus Rapid Transit Service, travel through this area. Table 4.5-2 describes the existing bus routes serving the NEMC Portal area.

Table 4.5-2 – Transit Service in the Vicinity of the NEMC Portal

Bus Number	Origin – Destination	Peak-Hour Headways (min.)
Bus #3	City Point – Chinatown via BMIP	22
Bus #11	City Point – Downtown Bayview Route	6 – 11
Bus #43	Ruggles Station – Park & Tremont Streets	10 – 15
Silver Line Phase I Bus Rapid Transit	Dudley Square – Downtown via Washington Street	4
Orange Line Rapid Transit	New England Medical Center Station	5

4.5.1.2 Pedestrians

Streets within the study area have acceptable pedestrian facilities with sidewalks on both sides. Sidewalk widths vary from 6 to 16 feet along Washington Street and range from poor to good condition. Crosswalks are provided at all of the signalized intersections within the study area. Despite this, some pedestrians cross at mid-blocks (e.g. Washington Street close to the NEMC entrances, and on Charles Street close to the Transportation Building). For a more detailed description of the pedestrian environment, please refer to Section 4.12.

There is a permanent need for uninterrupted pedestrian access to major attraction points in the area including: the Boston Common, MBTA subway stations, the Theatre District, the Downtown Shopping and Financial Districts, and the New England Medical Hospital.

Existing pedestrian volumes and LOS were evaluated in the vicinity of the proposed NEMC portal and the results are presented in Table 4.5-3. The majority of pedestrians were observed to travel from the Orange Line and west side of Washington Street across the crosswalk. The intersections analyzed maintain a Level of Service A during peak hour which means there is sufficient sidewalk space provided for pedestrians.

Table 4.5-3 – NEMC Portal Pedestrian Volumes – Existing Conditions, 2004[1]

Location	Peak Hour[2]	LOS
NEMC Crosswalk from East	219	A
Orange Line/Garage from West	930	A
Washington Street South (West Side)	53	A
Washington Street North (West Side)	48	A

Notes:
1. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, May 2004
2. Peak hour is 7:45 AM to 8:45 AM

4.5.1.3 Bicycle Facilities

Tremont Street, Boylston Street, Oak Street, Marginal Road and Stuart Street are recommended as on-street bicycle routes in the Boston Bike map. The City of Boston is in the process of installing U-shaped bicycle racks at locations and two racks are located at the intersections of Tremont Street and Avery Street and Washington Street and Avery Street[8].

4.5.2 Columbus Avenue Portal Area

4.5.2.1 Transit

A combination of rapid transit, bus and commuter rail services the Columbus Avenue Portal area. The Green Line has a stop at Arlington Street and there is a Back Bay Station on Dartmouth Street, south of Stuart Street, for MBTA Orange Line and Commuter Rail. A number of buses service the Columbus Avenue Portal area. The #9, #39 and #55 have a stop at the intersection of Clarendon Street and St. James Avenue. Bus #55 also stops at the corner of Arlington Street and St. James, and the #9 stops on Berkeley Street south of Columbus Avenue. In addition, there is one tour bus stop on Clarendon Street at Stanhope Street and a commuter bus stop on St. James Street at Berkeley Street. Other buses also stop at Back Bay Station, including the #10, #39, and #170. Table 4.5-4 describes the bus routes serving the Columbus Avenue Portal area.

[8] *Emerson College Institutional Master Plan (Howard/Stein Hudson Inc. for the transportation chapter) submitted to Boston Redevelopment Authority*

Table 4.5-4 – Transit Service in the Vicinity of the Columbus Avenue Portal

Bus Number	Origin – Destination	Peak-Hour Headways (min.)
Bus #9	City Point – Copley Square via Broadway Station	6 – 8
Bus # 39	Forest Hills – Back Bay	5
Bus #55	Jersey & Queensberry – Copley Sq. or Park & Tremont Streets	14 – 17

4.5.2.2 Pedestrians

Streets within the study area have acceptable pedestrian facilities with sidewalks on both sides. Sidewalk widths vary from 8 to 9 feet along Columbus Avenue between Arlington and Berkeley Streets and range from poor to good condition. Crosswalks are provided at all of the signalized intersections within the study area. Despite this, some pedestrians cross at mid-blocks. For a more detailed description of the pedestrian environment, please refer to Section 4.12.

Major attraction points for pedestrians in the area are similar to those for NEMC: the Boston Common, MBTA subway stations (Back Bay Station, Arlington Station, Boylston Station) the Theatre District, and the Downtown Shopping and Financial Districts.

Pedestrian counts were conducted in the vicinity of the future portal to determine the existing peak hour volumes and the LOS of pedestrian routes serving the Columbus Avenue Portal. The results are presented in Table 4.5-5 and conclude that there is adequate capacity for pedestrians at any time of the day at the studied intersections since all the peak hour volumes run at LOS A.

Table 4.5-5 – Columbus Portal Pedestrian Volumes – Existing Conditions 2004

Location	Peak Hour	LOS
Columbus Ave/Berkeley St.[1]	**8:00 AM – 9:00 AM**	
Columbus Ave North	389	A
Columbus Ave South	235	A
Berkeley St West	121	A
Berkeley St East	228	A
Arlington St/Columbus Ave/Stuart St.[2]	**5:00 PM – 6:00 PM**	
Arlington St South	349	A
Columbus Ave Southwest	285	A
Stuart St West	275	A
Arlington St North	241	A
Columbus Ave Northeast	176	A
Stuart St East	135	A

Notes:

1. 2004 pedestrian counts from the Clarendon Draft Project Impact Report, June 2004
2. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, September 2004

4.5.2.3 Bicycle Facilities

There are no existing bike paths through the study area. However, there are streets in the area recommended as on-street bicycle routes in the Boston Bike map.

4.6 Air Quality

The federal Clean Air Act (CAA) and subsequent Clean Air Act Amendments (CAAA) established timeframes for states to meet and maintain National Ambient Air Quality Standards (NAAQS) for criteria pollutants. The U.S. Environmental Protection Agency (EPA) is responsible for setting NAAQS levels to protect public health. Table 4.6-1 shows the criteria pollutants and their associated NAAQS. States are required to monitor the ambient air to determine if these standards are being met. If air quality does not meet a standard, states are required to develop and implement control programs to attain the standard. Once the standard is attained, programs may be required to assure that the standard will be maintained. States must formally specify their attainment and maintenance plans in a State Implementation Plan (SIP).

Table 4.6-1 – National Ambient Air Quality Standards

Pollutant	Primary Stds.	Averaging Times	Secondary Stds.
Carbon Monoxide	9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)	8-hour[1] 1-hour[1]	None None
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	Annual (Arith. Mean)	Same as Primary
Particulate Matter (PM_{10})	50 µg/m^3 150 µg/m^3	Annual[2] (Arith. Mean) 24-hour[1]	Same as Primary
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3 65 µg/m^3	Annual[3] (Arith. Mean) 24-hour[4]	Same as Primary
Ozone	0.08 ppm 0.12 ppm	8-hour[5] 1-hour[6]	Same as Primary Same as Primary
Sulfur Oxides	0.03 ppm 0.14 ppm ---------	Annual (Arith. Mean) 24-hour[1] 3-hour[1]	------- ------- 0.5 ppm (1300 ug/m^3)

1. Not to be exceeded more than once per year.
2. To attain this standard, the expected annual arithmetic mean PM10 concentration at each monitor within an area must not exceed 50 µg/m^3.
3. To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
4. To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 µg/m^3.
5. To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
6. (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is <= 1, as determined by appendix H.
   (b) The 1-hour NAAQS will no longer apply to an area one year after the effective date of the designation of that area for the 8-hour ozone NAAQS. The effective designation date for most areas is June 15, 2004. (40 CFR 50.9; see Federal Register of April 30, 2004 (69 FR 23996).)

A nonattainment area is a designated geographic area that does not meet NAAQS for certain criteria pollutants. Eastern Massachusetts, including all of Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk, and Worcester counties, has been classified by the EPA as an ozone (O_3) nonattainment area. As a result of this designation, the CAAA requires Massachusetts to reduce emissions of volatile organic compounds (VOCs) and nitrogen oxides

(NOx), the two major precursors to ozone formation, in order to attain the ozone standard by 2007 and beyond.

There are currently two NAAQS for ozone. Prior to 1997, the standard for ozone had been 0.12 parts per million (ppm) averaged over one hour. Massachusetts has been classified as "serious non-attainment" for the one-hour standard since the early 1990s. However, as a result of numerous control programs, Massachusetts has made significant progress in reducing the number and severity of one-hour O_3 exceedances. In 1997, the EPA set a new stricter ozone standard of 0.08 ppm averaged over an eight-hour period. EPA designated Massachusetts as "moderate non-attainment" for the new eight-hour ozone standard effective June 15, 2004. After June 15, 2004, Massachusetts no longer reports one-hour O_3 levels and only reports eight-hour values, although programs that have been previously instituted to attain the one-hour standard will be maintained in order to achieve the eight-hour standard.

The last violation of the Carbon Monoxide (CO) standard in Massachusetts occurred in 1986. While Boston was classified as attainment for CO in 1996, air quality conformity analysis must still be completed for Boston, consistent with the SIP, as part of the SIP's carbon monoxide maintenance plan. The conformity determination requirement at the "project level" requires the inclusion of a "hot-spot" analysis to ensure that new transportation projects in the CO attainment area do not cause or contribute to possible CO nonattainment.

There are currently two NAAQS standards for particulate matter, which are tiny airborne particles or aerosols, which include dust, dirt, soot, smoke, and liquid droplets: PM_{10} and a newer $PM_{2.5}$ standard. Massachusetts has been in attainment of the PM_{10} standard for many years and current monitoring also shows attainment of the $PM_{2.5}$ standard. Implementation of the $PM_{2.5}$ standard has been delayed due to various suits which challenged the standard. EPA issued official designations for the PM2.5 standard on December 17, 2004 and made modifications in April 2005. Based on EPA's designations, the entire state of Massachusetts is classified as attainment/unclassifiable. Massachusetts has been in attainment for sulfur dioxide, nitrogen dioxide, and lead for many years.

Although there have been no NAAQS established for carbon dioxide (CO_2), the Federal Transit Administration's New Starts evaluation of environmental benefits also requires an assessment of project impacts on CO_2 emissions. CO_2 is a common naturally-occurring compound on Earth but is also classified as a "greenhouse gas." Greenhouse gases trap heat within the atmosphere and there is evidence that increasing levels of greenhouse gases in the atmosphere may be causing global climate change. CO_2 produced through the consumption of fossil fuels in the operation of various transportation modes is a primary source of manmade CO_2 emissions.

4.7 Noise and Vibration

This section describes existing noise and vibration conditions along the Silver Line Phase III Alternatives. Construction noise and vibration impacts are discussed in Chapter 6. There are a number of laws and guidelines at the Federal level that direct the consideration of ground transportation noise and vibration impacts. These include:

- National Environmental Policy Act (42 U.S.C. 4321, et. seq.) (PL-91-190) (40 C.F.R. 1506.5);
- Noise Control Act of 1972 (42 U.S.C. 4910);
- FTA Transit Noise and Vibration Impact Assessment (DOT-T-95-16, April 1995);
- HUD Environmental Standards (24 C.F.R. Part 51);
- OSHA Occupational Noise Exposure; Hearing Conversation Amendment (FR 48 (46), 9738--9785 (1983).

The City of Boston Air Pollution Control Commission, acting under the authority for the General Laws of the Commonwealth of Massachusetts, has adopted Regulations for the Control of Noise in the City of Boston. While the regulations exempt various noise sources from local control (e.g., federally preempted sources such as motor vehicles on any public way) these noise sources must still be included in the baseline ambient noise measurements for a project. Also exempt from the Boston noise regulations are sounds that originate on construction sites, provided that such activities comply with other provisions of the regulations.

4.7.1 Noise and Vibration Metrics

Noise is commonly expressed in terms of decibels (dB). Because community noise is related primarily to human concerns, the noise that is measured and predicted is modified ("weighted") by a filter known as the A filter. This reduces the effects of low and very high-pitched sounds at which human hearing is not as sensitive. The resulting units are called A-weighted decibels (dBA), and are used to express sound levels.

Certain noise descriptors are preferred for use in describing community noise environments. These descriptors are based upon noise energy and are called the Equivalent Noise Level (Leq), and the Day-Night Average Sound Level (DNL or Ldn). Both descriptors are approved by various regulatory agencies for noise-related land use planning. The units for each of these descriptors are dBA. The most recent methodology recommended for assessing transit noise effects (Federal Transit Administration, 1995) uses Ldn as the noise descriptor of choice. Ldn accounts for the increased annoyance resulting from noise occurring during the nighttime hours (10:00 p.m. - 7:00 a.m.) by adding a 10 dBA penalty for noise occurring during this period.

Figures 4.7-1 and 4.7-2 show typical Leq and Ldn, respectively, for non-transit and transit sources. Comparing the auto traffic noise levels, the 1,000 autos per hour at 40 mph generate approximately 65 dBA Leq (Figure 4.7-1). Assuming this constant rate for the daytime period but only 100 autos per hour during the nighttime, the Ldn, would be 65 dBA.

Ground-borne vibration is a small, rapidly fluctuating motion transmitted through the ground. Ground-borne vibration diminishes (or "attenuates") fairly rapidly over distance. Some soil types transmit vibration quite efficiently; other types (primarily "sandy" soils) do not. There are several basic measurement units commonly used to describe the intensity of ground vibration. The descriptor used by FTA is the velocity decibel, abbreviated VdB. The velocity parameter best correlates with human perception of vibration. Thus, the response of humans, buildings and sensitive equipment to vibration is described in this section in terms of the root-mean square (RMS) velocity level in VdB units. As a point of reference, the average person can just barely perceive vibration velocity levels below 70 VdB (typically in the vertical direction).

A comparison of common ground-borne vibration levels is shown on Figure 4.7-3. Typical background vibration levels are between 50 and 60 VdB whereas the levels for minor cosmetic damage to fragile buildings or blasting are generally 100 VdB. Ground-borne vibration can cause ground-borne noise.

Figure 4.7-1 Typical Hourly L_{eq}

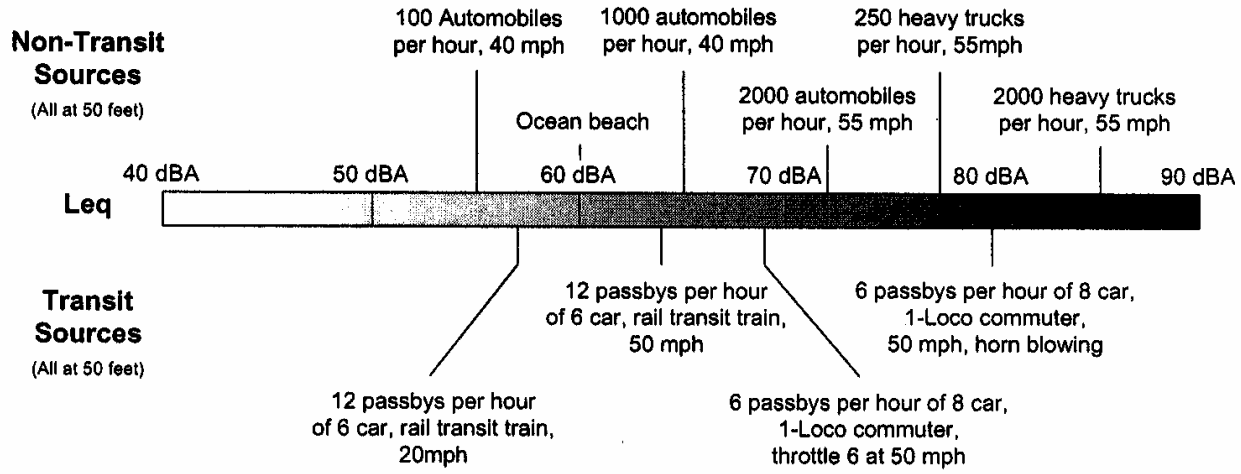

Non-Transit Sources
(All at 50 feet)
100 Automobiles per hour, 40 mph
1000 automobiles per hour, 40 mph
250 heavy trucks per hour, 55mph
Ocean beach
2000 automobiles per hour, 55 mph
2000 heavy trucks per hour, 55 mph
40 dBA
50 dBA
60 dBA
70 dBA
80 dBA
90 dBA
Leq
Transit Sources
(All at 50 feet)
12 passbys per hour of 6 car, rail transit train, 50 mph
6 passbys per hour of 8 car, 1-Loco commuter, 50 mph, horn blowing
12 passbys per hour of 6 car, rail transit train, 20mph
6 passbys per hour of 8 car, 1-Loco commuter, throttle 6 at 50 mph

Figure 4.7-2 Typical Hourly L_{dn}

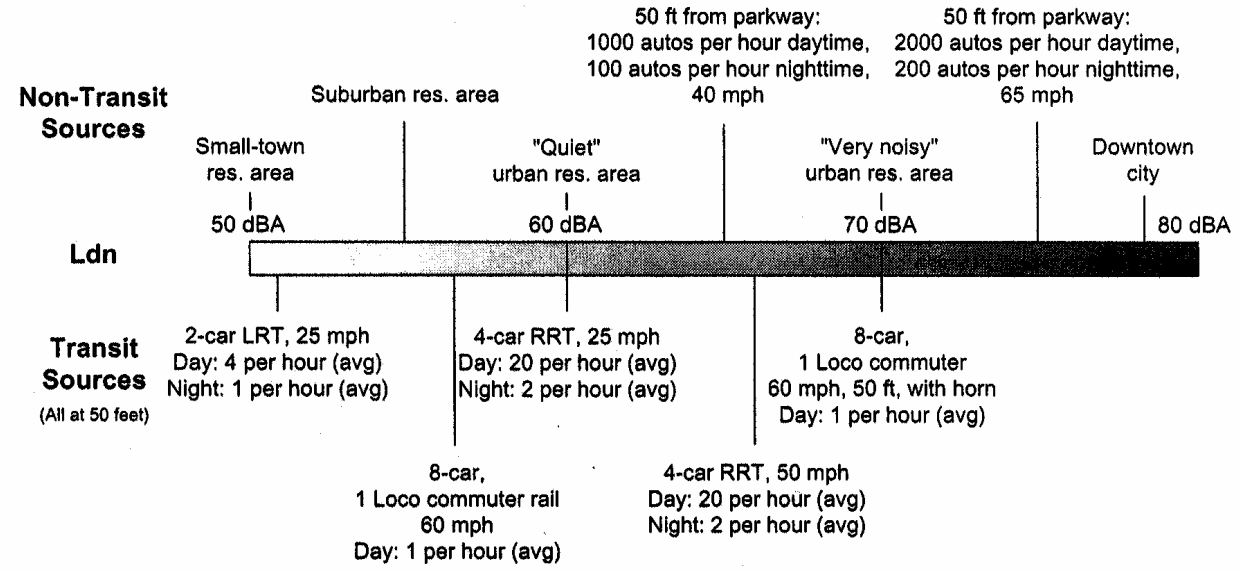
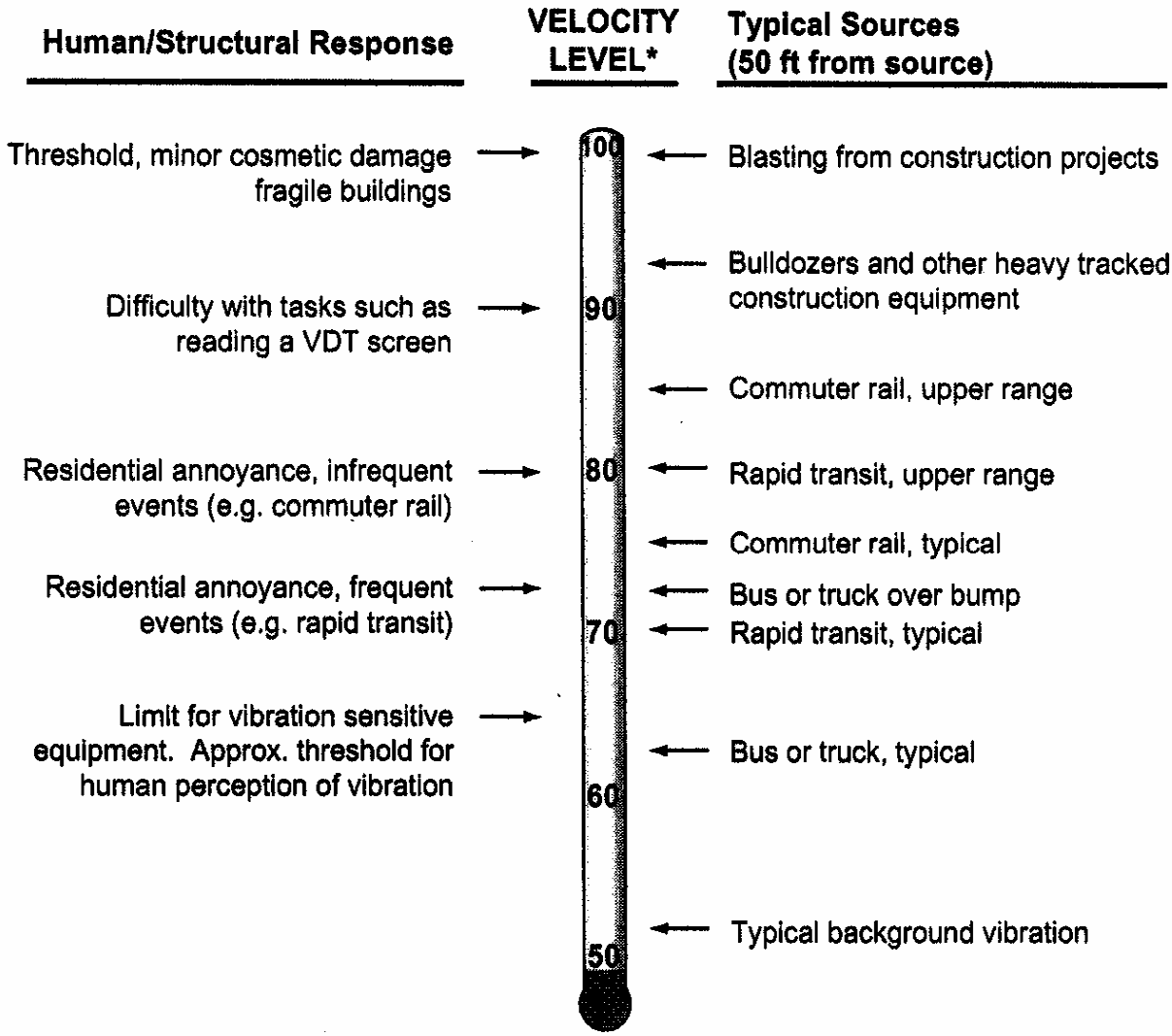

Non-Transit Sources
50 ft from parkway: 1000 autos per hour daytime, 100 autos per hour nighttime, 40 mph
50 ft from parkway: 2000 autos per hour daytime, 200 autos per hour nighttime, 65 mph
Suburban res. area
Small-town res. area
"Quiet" urban res. area
"Very noisy" urban res. area
Downtown city
50 dBA
60 dBA
70 dBA
80 dBA
Ldn
Transit Sources
(All at 50 feet)
2-car LRT, 25 mph
Day: 4 per hour (avg)
Night: 1 per hour (avg)
4-car RRT, 25 mph
Day: 20 per hour (avg)
Night: 2 per hour (avg)
8-car,
1 Loco commuter
60 mph, 50 ft, with horn
Day: 1 per hour (avg)
8-car,
1 Loco commuter rail
60 mph
Day: 1 per hour (avg)
4-car RRT, 50 mph
Day: 20 per hour (avg)
Night: 2 per hour (avg)

Figure 4.7-3 Typical Levels of Ground-Borne Vibration


Human/Structural Response
VELOCITY LEVEL*
Typical Sources (50 ft from source)
Threshold, minor cosmetic damage fragile buildings
Difficulty with tasks such as reading a VDT screen
Residential annoyance, infrequent events (e.g. commuter rail)
Residential annoyance, frequent events (e.g. rapid transit)
Limit for vibration sensitive equipment. Approx. threshold for human perception of vibration
100
90
80
70
60
50
Blasting from construction projects
Bulldozers and other heavy tracked construction equipment
Commuter rail, upper range
Rapid transit, upper range
Commuter rail, typical
Bus or truck over bump
Rapid transit, typical
Bus or truck, typical
Typical background vibration

** RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second*

4.7.2 Receptor Criteria

4.7.2.1 Noise

FTA's three receptor categories are:

- Noise Category 1: Tracts of land where quiet is an essential element in their intended purpose such as outdoor amphitheaters, concert pavilions and National Historic Landmarks with significant outdoor use (routine interpretation of the landmark).

- Noise Category 2: Residences and buildings where people normally sleep, including homes, hospitals and hotels.
- Noise Category 3: Institutional land use (schools, places of worship, libraries) with use typically during the daytime and evening. Other uses in this category can include medical offices, conference rooms, recording studios, concert halls, cemeteries, monuments, museums, historical sites, parks and recreational facilities.

Outdoor hourly Leq applies to categories 1 and 3 whereas outdoor Ldn applies to category 2. No category 1 land use was found within 500 feet of the proposed alignment. Because of its lower impact thresholds, the study focused on category 2 land use.

4.7.2.2 Vibration

The FTA assigns sensitive receptors to the following three categories:

- Vibration Category 1: High Sensitivity - Buildings where low ambient vibration is essential for the interior operations in the building. Vibration levels may be below the level of human perception.
- Vibration Category 2: Residential - Residences and buildings where people normally sleep. This includes private dwellings, hospitals and hotels where nighttime sensitivity is assumed to be of utmost importance. It also includes some special uses such as auditoriums or theaters.
- Vibration Category 3: Institutional - Land uses with primarily daytime use including schools, churches, other institutions and quiet offices that do not have vibration-sensitive equipment.

4.7.3 Existing Noise and Vibration Environment

The Silver Line Phase III project area consists of a mix of several urban land use types. The predominant land use type is commercial, but recreational, residential and institutional land uses also exist. In order to characterize the project area and as a point of comparison for project alternatives, ambient noise, vibration, and weather conditions were measured along the proposed alignment and extensions during a three-day period from Tuesday November 4, 2003 through Thursday, November 6, 2003 and a subsequent four-day period from Tuesday October 19, 2004 through Friday October 22, 2004.

Refer to Technical Appendix C for a complete list of the instruments used in the study to measure noise, vibration, weather, and traffic.

4.7.3.1 Noise

Two types of noise measurements were conducted: Short-Term (ST) and Long-Term (LT). The ST measurements, consisting of 12 separate measurements at 11 representative locations, were each 15 minutes duration. These sampling measurements are considered representative of the hourly noise level occurring at the measurement sites. The measurement locations are shown on Figure 4.7-4. Five of the ST measurements (ST-1, ST-2, ST-4, ST-5 and ST-8) and two of the LT measurements (LT-4, LT-3) were along the Core Tunnel Segment. Three ST locations (ST-3, ST-6 and ST-7) and three LT locations (LT-1, LT-2 and LT-5) were chosen along the Tremont, Charles, and Stuart Street Alignments with most of these at the southern ends. For the Columbus Avenue Alignment, four ST locations (ST-9, ST-10, ST-11 and ST-12) and one LT location (LT-6) was chosen.

The ST and LT noise measurement data is summarized in Table 4.7-1 and Table 4.7-2, respectively. Noise associated with typical downtown urban activity (e.g., traffic and commercial) dominates the environmental noise level in the project area. The measured noise levels were typical for the project area's land uses.

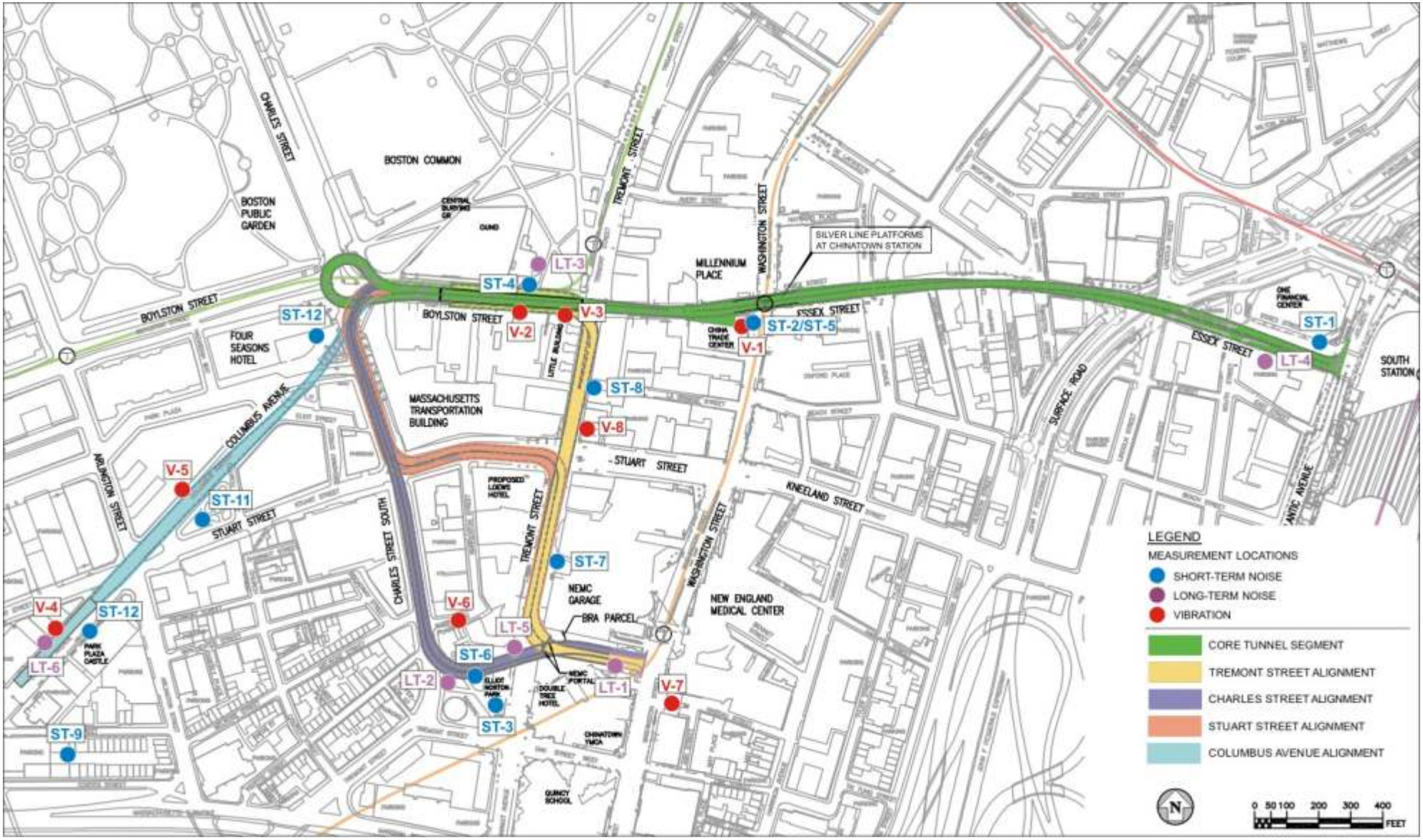


Figure 4.7-4
Noise and Vibration Measurement Locations

The 15-minute Leq obtained from the 12 ST location measurements ranged from 61 dBA at the parking lot of 40 Isabella Street (ST-9) to 73 dBA on the southeast corner of Tremont Street and La Grange Street (ST-8). Street traffic was the predominant noise source at all ST locations. Day-Night Average Sound Level (DNL) among the six LT locations ranged from 70 dBA adjacent to the Doubletree Hotel (LT-1) and Boston Common (LT-3) to 79 dBA at Elliott Norton Park and at the southeast corner of Essex Street and South Street.

Although the noise levels differ at each of the six measurement locations, a brief comparison indicates that the general diurnal noise patterns are similar. The quietest hour of the 24-hour period is centered around 2 – 3 AM, followed by a rapid increase in the noise level beginning at 3 or 4 AM. The noise levels tend to reach a local maximum level in the early morning hours and then stabilize (within approximately 5 decibels) for the rest of the daytime hours, at which point the noise levels decline again. The lowest 1-hour Leq measured at any of the four locations was 59 dBA, at LT-1 (adjacent to the Doubletree Hotel) during the 2 – 3 AM hour.

4.7.3.2 Vibration

During the October 2004 noise survey, ambient vibration measurements were also conducted. A total of 9 attended vibration (V) measurements were made at 8 different locations along the proposed alignment and extensions.

The vibration measurement sites were chosen to represent potentially vibration-sensitive buildings and uses. The measurement locations are shown on Figure 4.7-4 and described in Table 4.7-3. Three of the vibration measurements (V-1, V-2 and V-3) were along the Core Tunnel Segment. Three locations (V-6, V-7 and V-8) were chosen along the Tremont, Charles and Stuart Street Alignments with most of these at the southern ends. For the Columbus Avenue Extension Alternative, two vibration locations (V-4 and V-5) were chosen.

Of the eight vibration measurement sites, five sites are near existing vibration sources. Site V-4 (139 Columbus Ave.) was on the sidewalk in front of Benjamin Franklin Smith Printers. Sites V-1 (China Trade Center), V-2 (Colonial Theater), and V-3 (Little Building) were on sidewalks above the MBTA Green Line. Site V-8 (New England Medical Center) was on a sidewalk above the MBTA Orange Line. There are no aboveground freight or passenger rail lines in the project vicinity.

Table 4.7-1 – Short-Term Noise Measurement Data Summary

		Measurement Period				Measurement Results, dBA					
Site ID	**Measurement Location**	**Date**	Start Time	**Duration (minutes)**	**Predominant Noise Source**	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}
ST-1	NW corner of Atlantic Ave. and Essex St. (One Financial Center)	11/05/03	09:40	15	Street traffic (primarily Essex Street), distant construction noise, distant sirens	70.6	85.8	56.5	65.8	68.6	72.7
ST-2	SW corner of Boylston St. and Washington St. (Courtyard of China Trade Center)	11/05/03	13:50	15	Street traffic	71.1	81.1	63.8	65.7	69	74.1
ST-3	Elliot Norton Park, near Charles St. and north of Tremont St.	11/06/03	10:45	15	Street traffic, distant traffic, distant construction noise, distant children playing	63.5	75.7	57.4	59.1	61.5	66.6
ST-4	Adjacent to Central Burial Ground and Boylston Street Station, corner of maintenance area for cemetery.	11/06/03	11:15	15	Street traffic, delivery truck back-up alarm (briefly), distant siren	67.8	80.5	59.5	62.0	65.8	70.3
ST-5	Same as ST-2 (SW corner of Boylston St. and Washington St.)	11/06/03	11:25	15	Street traffic (including horns), distant construction	70.4	86.1	62.2	64.6	68.3	72.8
ST-6	Elliot Norton Park, north of Tremont Street	10/20/04	14:05	15	Street traffic, children playing, fan noise from NEMC	63.3	77.9	59.2	60.5	62.0	64.0
ST-7	Tremont St., between Wang Theater and NEMC parking structure	10/20/04	14:30	15	Street traffic, ambulance sirens, coach buses idling across street, suitcase wheels on brick sidewalk	66.4	81.7	59.2	61.0	64.0	68.5
ST-8	SE corner of Tremont St. and La Grange St. (216 Tremont St.)	10/20/04	15:00	15	Street traffic, bus accelerating in near lane (94.5 dB)	72.9	94.5	62.5	64.0	68.0	72.5
ST-9	Parking Lot of 40 Isabella St. (across street from back of Ladder 17 fire station)	10/20/04	15:55	15	Local and distant traffic, brake squeal, loudspeakers from front of fire station	60.7	66.8	57.3	58.5	60.0	63.5
ST-10	Columbus Ave. at The Castle, between Arlington St. and Isabella St.	10/20/04	16:15	15	Street traffic, police hand-held radio on sidewalk, medium trucks and buses	70.3	81.0	56.8	61.5	67.0	75.0
ST-11	Park at Stuart St., Columbus Ave., and Church St. (across Columbus Ave. from Park Plaza Hotel)	10/20/04	16:35	15	Street traffic, car horn in near lane of Stuart St (for approx. 10 sec)	66.4	85.3	59.2	61.0	64.5	68.0
ST-12	Park Plaza at Columbus Ave. NE of Park Plaza Hotel, S of Four Seasons Hotel	10/20/04	17:00	15	Street traffic (nearby construction site NOT active)	66.6	83.2	58.4	61.0	63.5	68.5

Table 4.7-2 – Long-Term Noise Measurement Data Summary

Site ID	Location	Measurement Date	Duration (hours)	Mean L_{eq} (dBA)	Mean L_{dn} (dBA)
LT-1	Adjacent to Doubletree Hotel, near Washington Street	11/4/03 -11/05/03	26	65.0	69.5
LT-2	Elliott Norton Park, adjacent to Charles Street South	11/4/03 -11/05/03	26	74.7	79.2
LT-3	Boston Common, near intersection with Tremont Street and Boylston Street, near Boylston Station	11/4/03 -11/05/03	26	66.8	70.2
LT-4	SE Corner of Essex Street and South Street	11/4/03 -11/05/03	26	73.6	79.3
LT-5	Elliot Norton Park, immediately S of assisted living facility and Millennium Day Care	10/20/04-10/22/04	28	66.5	73.2
LT-6	Salvation Army parking lot on Columbus Ave, between 147 Berkeley and 147 Columbus	10/20/04–10/22/04	28	68.7	75.0

Table 4.7-3 – Vibration Measurement Data Summary

Site ID	Location	October 19, 2004 Start Time (24 hour)	Duration (minutes)	Vibration Source	Average Particle Velocity (Vrms, micro-inch / second)	Estimated* Peak Particle Velocity (PPV, micro-inch / second)	Vibration Velocity Level (L_V, VdB re 1 micro-inch / second)**
V-1	China Trade Center, Boylston Entrance; sidewalk above MBTA Orange Line Chinatown Station	11:46	10	dense auto traffic; some medium trucks and buses; (Orange Line not noticeable if running)	740	2960	57.4
V-2	Colonial Theatre, 106 Boylston; sidewalk above MBTA Green Line Boylston Station	12:25	10	city traffic - cars and medium trucks; (Green Line not noticeable if running)	536	2144	54.6
V-3	Little Bldg, 80 Boylston (Emerson College residence hall); sidewalk above MBTA Green Line Boylston Station	12:47	10	city traffic; (Green Line not noticeable if running)	932	3728	59.4
V-4	139 Columbus Ave, Benjamin Franklin Smith printers sidewalk; near proposed Columbus Ave portal	14:16	10	city traffic, box dollies rolling down stoop	375	1500	51.5
V-5	Park Plaza Hotel, 64 Arlington, Columbus entrance; across street from Boston Renaissance Charter School and residences above South Cove Plaza retail	14:48	10	city traffic	399	1596	52.0
V-6	Lyndeboro Place Townhouses courtyard; vicinity of assisted living facility, Tremont House Hotel, Doubletree Hotel	15:42	10	distant traffic	287	1148	49.2
V-7	NEMC South Bldg, 860 Washington @ Nassau; near proposed Charles/Tremont portals; above MBTA Orange Line	16:26	10	city traffic	549	2196	54.8
V-8	228 Tremont St.; adjacent to upper-floor residences and on block of Emerson College classrooms; above MBTA Orange Line	16:56	10	city traffic	636	2544	56.1

* PPV = 4*Vrms

** $Lv = 20*\log_{10}(Vrms/10^{-6})$, where Vrms is the average particle velocity in inches/second

† caused by peak at 10 Hz of unknown origin; peak not repeated in measurement V-6b

4.8 Geology and Groundwater

Geology and groundwater considerations affect the design and construction of all tunnel projects. During design, the geologic and groundwater conditions along the Silver Line Phase III alignment will dictate the structural and waterproofing requirements of the tunnel itself. During construction, these conditions influence the types and amounts of earth support, soil improvement, and dewatering that might be required.

The effect of geology and groundwater is also a consideration with regard to structures near the Silver Line Phase III alignments, particularly those structures that are founded on timber piles. The timber piles that support these structures, most of which are located in the Bay Village and Back Bay neighborhoods, are susceptible to rot and decay if prolonged drops in the groundwater table occur. In addition, a drop in the groundwater table can cause certain soils to consolidate, in turn causing structures that are founded above these soils to settle.

4.8.1 Geology

4.8.1.1 Bedrock Geology

The Silver Line Phase III alignment alternatives are located in the structural and topographic depression known as the Boston Basin. The Basin is located at the eastern portion of the Appalachian orogenic zone. The Basin is an east-northeast trending, roughly triangular-shaped downfaulted area that widens toward the coast. Bedrock in the Basin consists of Precambrian to Cambrian age sedimentary, metamorphic, and volcanic rock. The sedimentary rock, which lies above the Precambrian igneous rock, include conglomerates, sandstones, argillites, and volcaniclastic sediments that were eroded from the surrounding highlands and fault scarps.

In general, the bedrock surface within the Boston Basin slopes gently downward toward the east, but locally it is extremely irregular due to the existence of faults, dikes, and glacially scoured and erosional depressions.

The predominant bedrock in the project area is the Cambridge argillite, which is very thinly and steeply bedded. Depending on the degree of weathering and fracturing, the argillite can be highly variable in its properties.

4.8.1.2 Surficial Geology

The project area was extensively glaciated during the Wisconsin Period. Repeated retreats and re-advances of the glacier between about 18,000 and 12,000 years ago fractured and scoured the bedrock leaving behind a complex deposit of soils including basal tills, moraines, drumlins, and outwash deposits. During glacial retreats, fine-grained soils, including silts and clays, were carried to the ocean by rivers and streams and deposited in quiet marine waters. The thickness of soil overburden in the project area is between about 70 and 150 feet.

After the glaciers retreated, organic soils were deposited in tidal marsh areas along the shoreline and in river estuaries. The Colonial shoreline of Boston is defined by an area known as the Shawmut Peninsula. At high tide, the peninsula was an approximately 783-acre island. During low tide, it was surrounded by mud flats. In recent history, landfill was placed in many areas to reclaim low-lying and submerged areas as Boston expanded. The thickness of fill in the project area ranges between about 5 and 20 feet.

Most of the Silver Line Phase III alignments lie within the Shawmut Peninsula except for the Columbus Avenue alternative. Figure 4.8-1 shows the proposed alignments in relation to the colonial shoreline.

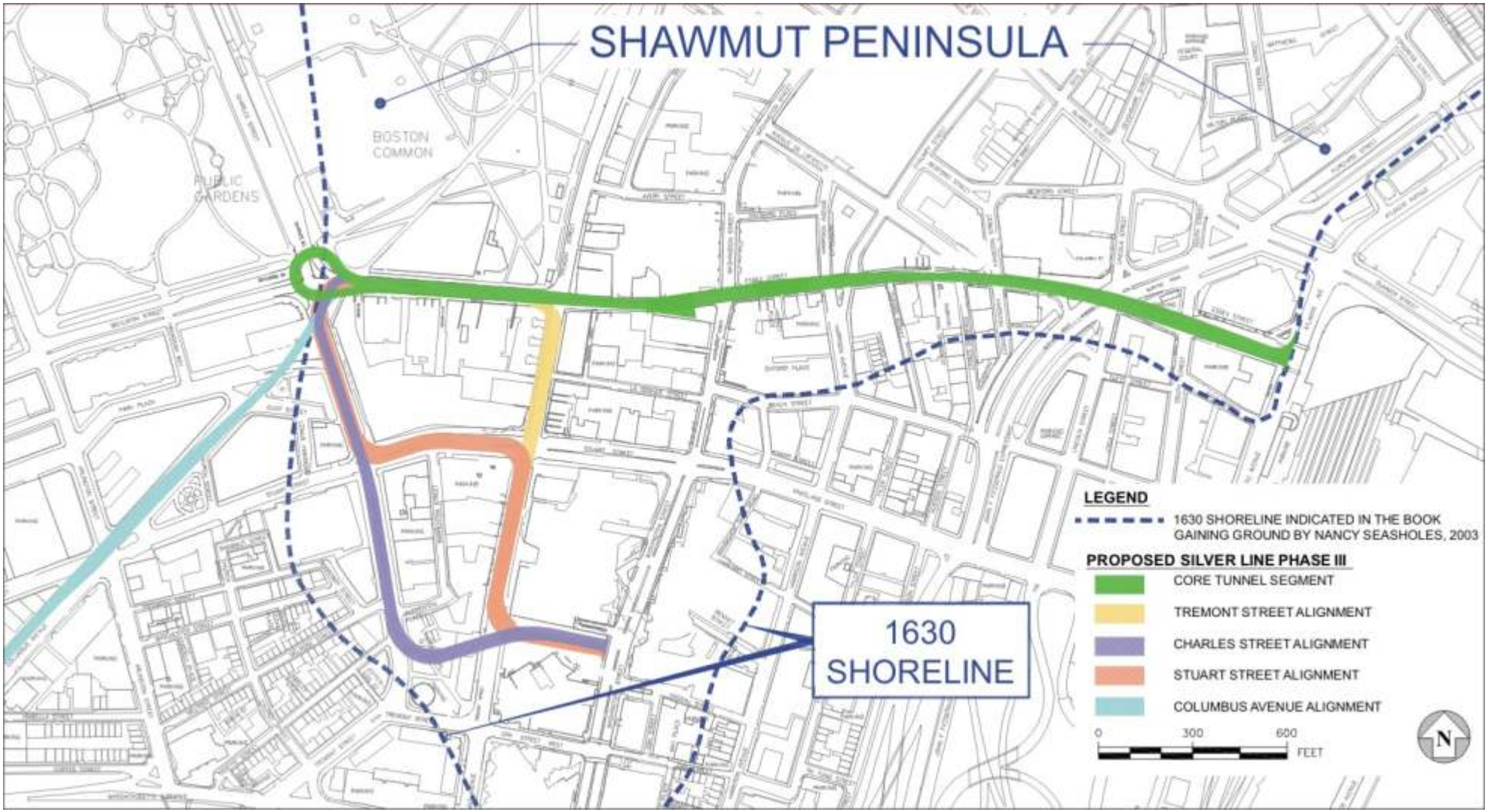


Figure 4.8-1
Location of Shawmut Peninsula

4.8.2 Groundwater

The groundwater in the project area can be divided into two aquifers: an (upper) unconfined aquifer in the fill, and a (lower) confined aquifer in the glacial till and fractured bedrock. The groundwater levels in the two aquifers are generally independent of each other. The nearest surface water bodies that surround Boston and influence area groundwater are Boston Harbor and the Charles River Basin. Boston Harbor, which is tidal, typically ranges between (elevation) El. 93 and El. 107 (CA/T datum)[9]. The Charles River Basin is maintained at approximately El. 102.35 by a dam.

Groundwater levels in the upper aquifer can be affected locally by leakage into tunnels and sewers below the water table, which lowers the groundwater level, or by leakage from water mains that can raise the groundwater level. The groundwater level in the upper aquifer throughout the project area generally ranges from El. 94 to El. 110. This elevation range is based on water level measurements collected in monitoring wells installed by the MBTA and the Boston Groundwater Trust. The MBTA has coordinated with the Groundwater Trust to determine existing water level measurements and to identify local groundwater issues that are further discussed in Chapter 5.

Piezometric groundwater levels[10] in the lower aquifer are generally lower than those in the upper aquifer. This is because groundwater recharge into the lower aquifer tends to be very slow due to the low permeability of the surrounding soil and rock. In addition, some buildings in the area with very deep basements have underdrain systems to locally maintain groundwater levels in the lower aquifer below their basement levels. Experience has shown that pumping from this lower aquifer not only affects local groundwater levels, but also can affect the groundwater level in the lower aquifer many blocks away. Along southern portions of the Central Artery project, near the eastern end of the Silver Line Core Tunnel Segment, groundwater piezometeric levels in the glacial till are generally around El. 95, but range between El. 86 and El. 97.

Groundwater levels in the upper aquifer and piezometric levels in the lower aquifer have been measured in wells maintained by the Boston Groundwater Trust, in wells for previous projects, and in wells installed for the Silver Line Phase III project. Additional wells in both the upper and lower aquifers will be installed as the Silver Line Phase III design proceeds.

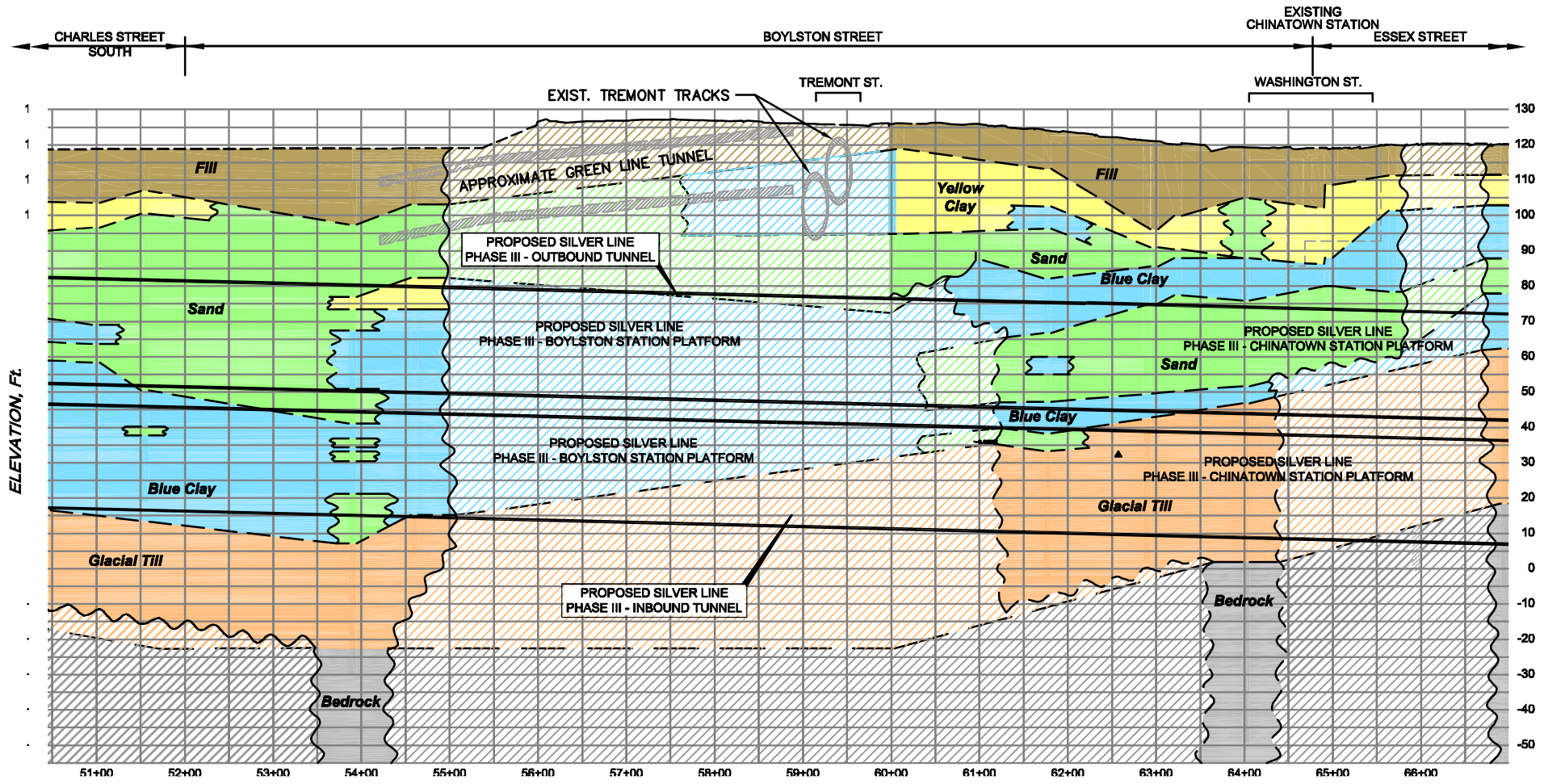
4.8.3 Subsurface Geology and Groundwater Profiles

In general, the subsurface profile along the Silver Line Phase III alignment consists of the following layers beginning at the ground surface and proceeding downward: fill, organic soil (in areas west of the colonial shoreline), marine clay and sand, glacial till, and bedrock. Each of these layers is described in Table 4.8-1 below.

The subsurface profile along the Silver Line Phase III tunnel alignments is shown in Figures 4.8-2 through 4.8-6. The profile has been divided into five sections: 1) the Core Tunnel Segment, which extends from South Station, along Essex and Boylston Streets to Charles Street; 2) the Tremont Street Alignment; 3) the Charles Street Alignment; 4) the Stuart Street Alignment, and 5) the Columbus Avenue Alignment.

[9] Elevations for the Silver Line project are in feet and are referenced to the Central Artery (CA/T) datum. El. 100 CA/T datum is set at Mean Sea Level (1929). Groundwater elevations in Boston are often referenced to Boston City Base (BCB) datum. Mean Sea Level (1929) is at El. 5.65 BCB datum. To convert an elevation from CA/T datum to BCB datum, subtract 94.35 feet.

[10] Piezometric groundwater levels represent the pressure or head corresponding to the height of water in an observation well penetrating an aquifer.



LEGEND

STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

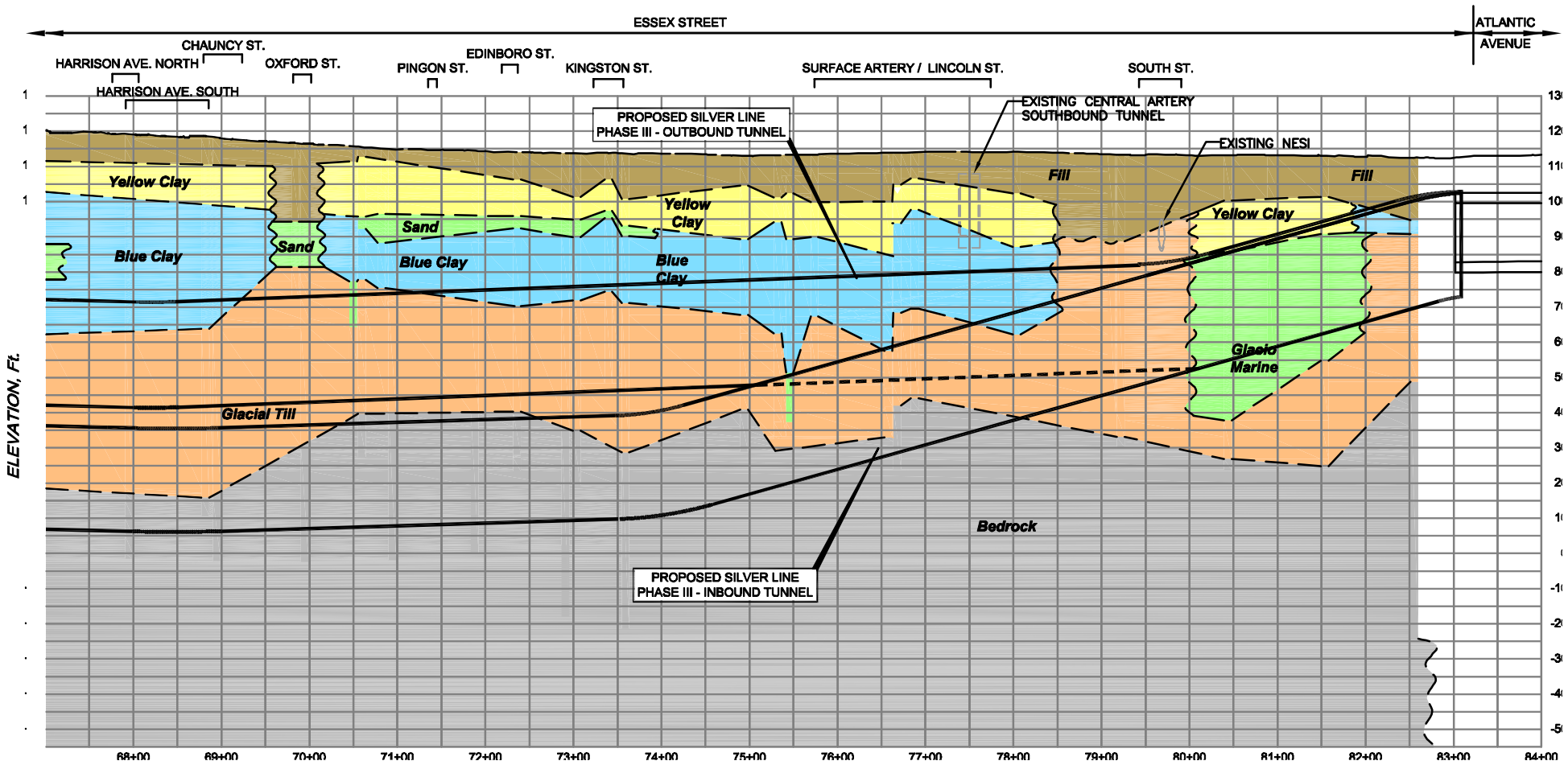
HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.8-2a
Soil Profile - Core Tunnel Segment Along Essex Street



LEGEND

STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

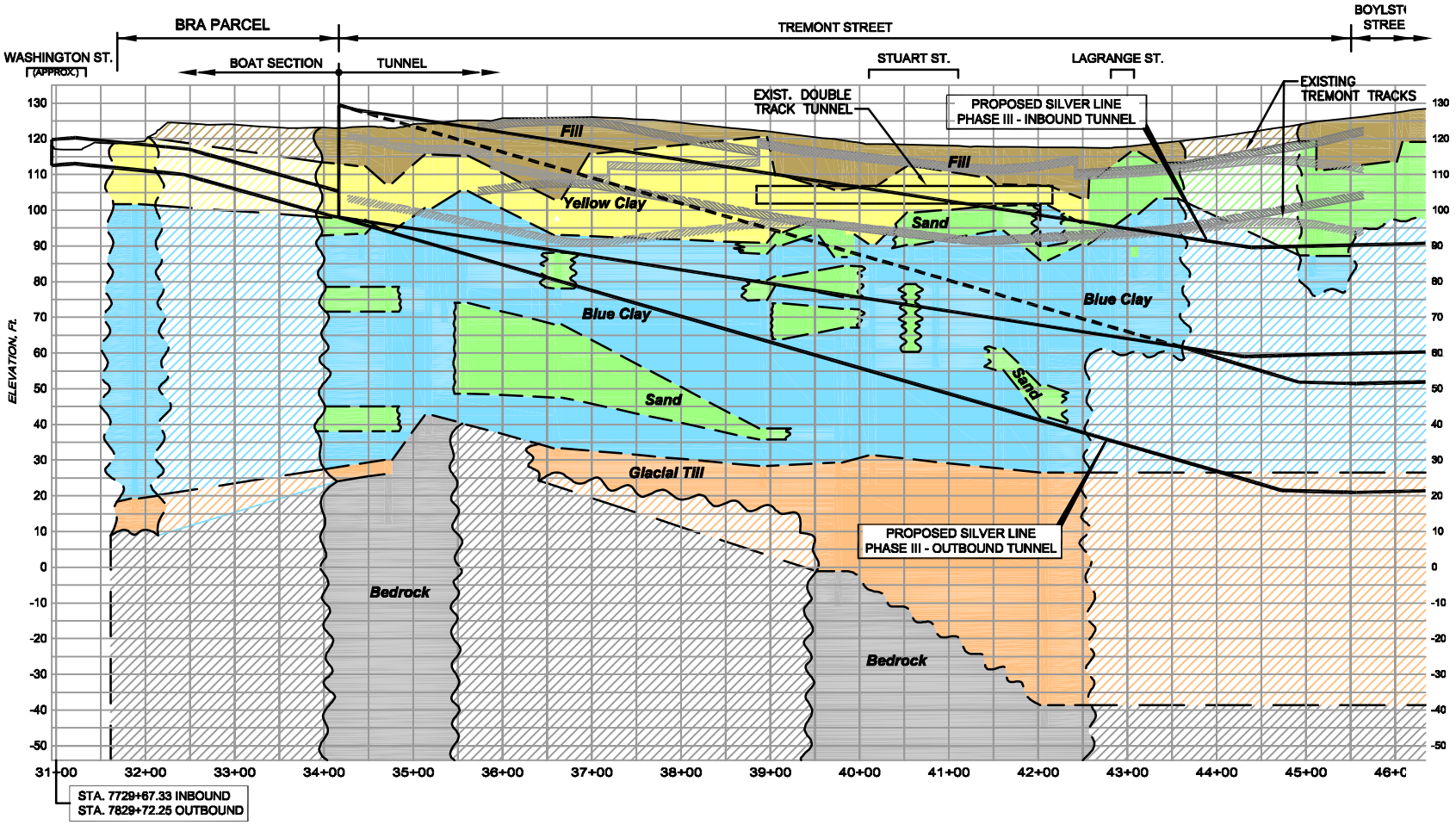
HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.8-2b
Soil Profile - Core Tunnel Segment Along Boylston Street



LEGEND

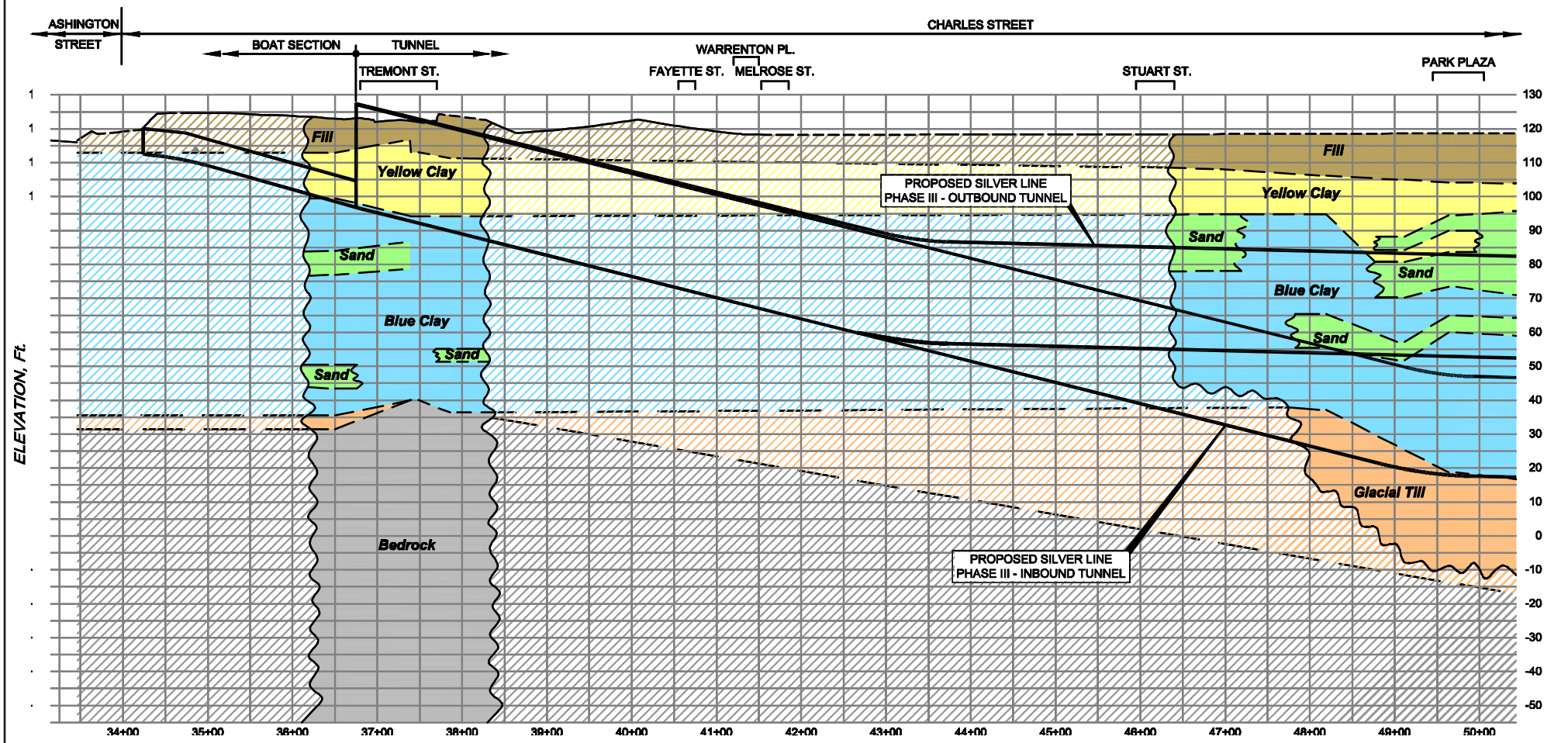
STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

Figure 4.8-3
Soil Profile - Tremont Street Alignment



LEGEND

STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

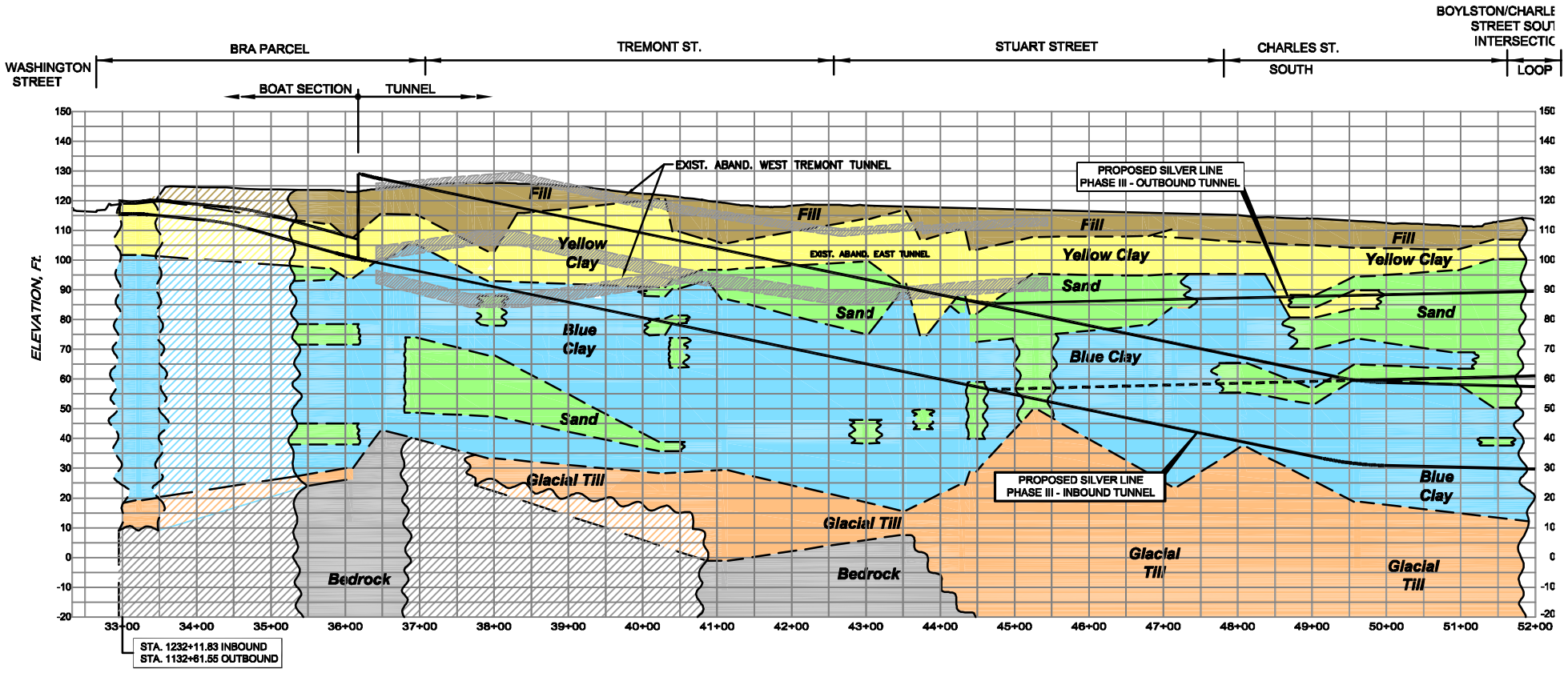
HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.8-4
Soil Profile -
Charles Street Alignment



LEGEND

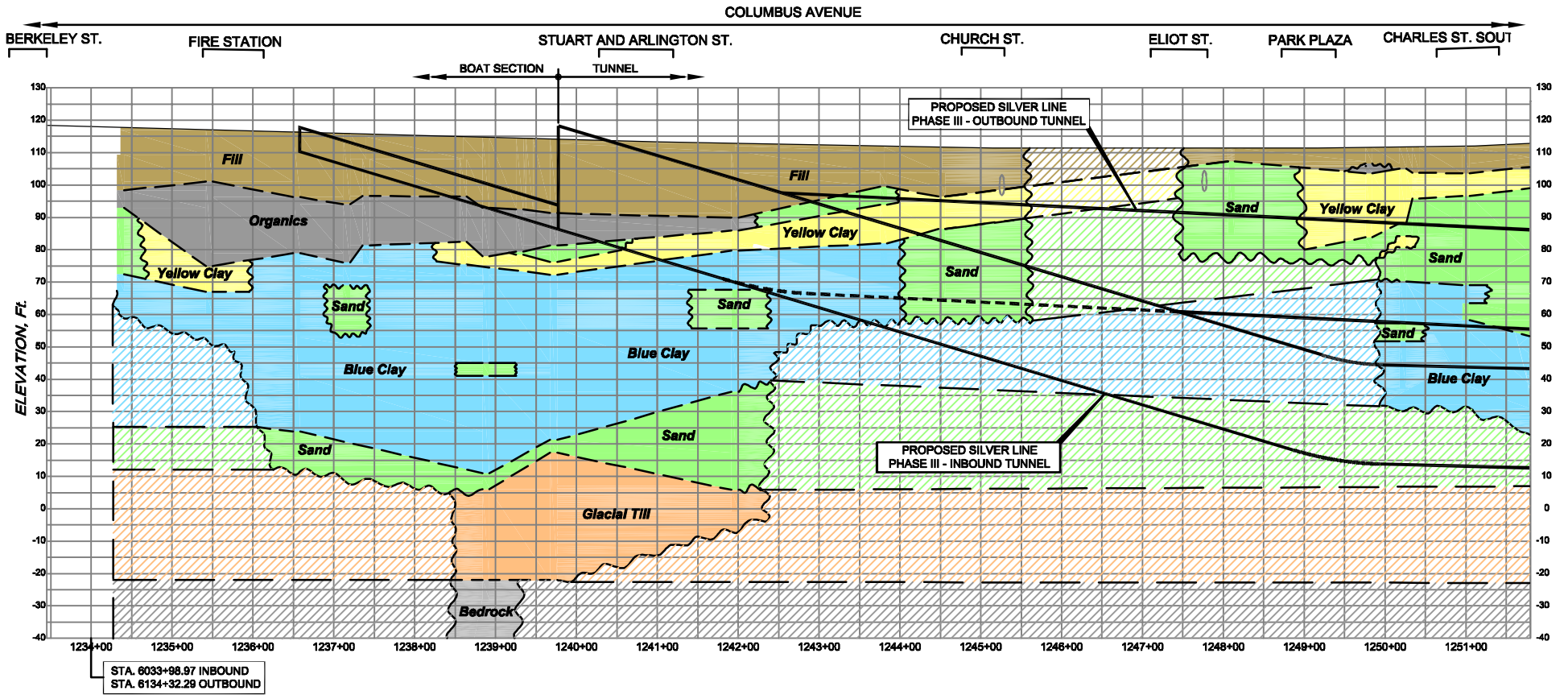
STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

Figure 4.8-5
Soil Profile - Stuart Street Alignment



LEGEND

STRATA

- FILL
- YELLOW CLAY
- SAND
- BLUE CLAY
- STRATIFIED CLAY & SAND
- TILL
- ROCK
- STRATA ASSUMED; NOT FACTUAL

HORIZONTAL SCALE, FEET
0 120 240

0 30 60
VERTICAL SCALE, FEET
NOTE: 4x VERTICAL EXAGGERATION

Figure 4.8-6
Soil Profile -
Columbus Avenue Alignment

Table 4.8-1 – Description of Subsurface Layers

Stratum	Description
Fill	Much of Boston was raised with artificial landfill regardless of whether it was originally a natural ground area or mud flats. The fill is highly variable in composition, even within a small area. The fill can be divided into two general types: granular (sandy) and cohesive (clayey). The data collected to date from the borings along the proposed alignment indicate that the fill is mostly granular and consists of fine to coarse sand with varying amounts of gravel and silt. Debris such as brick fragments, cinders and ash, concrete, metal, wood, shells, slag, and asphalt are also frequently encountered in the fill.
Organic Soil	A layer of organic soil is anticipated to be present in areas at the edge or beyond the colonial shoreline. These areas were at one time tidal marsh and estuarine environments. Organic deposits have been encountered along Charles Street South, where the alignment is near the shoreline, and along Columbus Avenue, which is west of the shoreline.
Marine Clay and Sand	The marine clay, commonly known as Boston blue clay, often has two distinct zones: the stiff upper "yellow" clay, and the lower medium to soft gray or olive clay. Both zones of clay typically contain seams or layers of silty fine sand, varying in thickness from 1/32 inch to several feet.
Glacial Till	Glacial till consists of a heterogeneous mixture of clay, silt, sand, and gravel, with occasional cobbles and boulders. In general, the major constituent is either silty sand or sandy silt.
Bedrock	Based on geologic maps, the bedrock in the area is predominantly Cambridge Argillite, which is a slightly metamorphosed claystone. The Argillite is often highly fractured, and often severely weathered, sometimes to the consistency of stiff clay. Intrusions of harder rock are sometimes encountered in the Argillite.

The profiles are based on borings performed for the Silver Line Phase III project, the CA/T project, and several other projects located near the proposed tunnel alignment. The subsurface conditions are known only at the boring locations. The soil layer boundaries are based on linear interpolation between borings. Actual soil layer boundaries may vary substantially from those shown in the figures. The subsurface profiles for each of these four sections are discussed below.

4.8.3.1 Core Tunnel Segment

Except for the end of the section at Charles Street, the alignment lies within the former Shawmut Peninsula. Starting at the ground surface and proceeding downward, the subsurface profile along the alignment consists of the following:

Urban Fill – A 5- to 25-foot-thick layer of urban fill is present along the entire section of the alignment.

Stiff Yellow (Marine) Clay – A layer of stiff yellow clay ranging from 5 to 20 feet thick clay lies below the fill.

Marine Clay and Sand – A 25- to 90-foot-thick layer of marine clay and sand is present beneath the yellow clay or fill. This layer occurs at depths ranging from 5 to 25 feet below ground surface. The marine clay and sand layer is continuous throughout the alignment and becomes thicker as the alignment moves from east to west.

Glacial Till – A 25- to 50-foot-thick layer of glacial till lies beneath the marine clay and sand layer. The top of the till is at depths ranging between 25 and 110 feet below ground surface. In general, the depth to this layer increases as the alignment moves from east to west. This layer is continuous throughout the alignment.

Bedrock – Bedrock is about 65 feet below ground surface (El. 45) near the east end of the alignment and 140 feet below ground surface (El. -25) near the west end of the alignment. The depth to bedrock increases as the alignment moves from east to west.

Groundwater levels in the upper aquifer along the Core Tunnel Segment ranged between 10 and 28 feet below ground surface (El. 92 to El. 110). Groundwater levels in the lower aquifer will be measured as deep wells are installed for the Silver Line Phase III design.

4.8.3.2 Tremont Street Alignment

The Tremont Street Alignment lies within the former Shawmut Peninsula. Starting at the ground surface and proceeding downward, the subsurface profile along the alignment consists of the following:

Urban Fill – A 5- to 20-foot-thick layer of urban fill exists along the entire section of the alignment.

Stiff Yellow (Marine) Clay – A 5- to 15-foot-thick layer of stiff yellow clay lies below the fill. This layer appears mainly south of La Grange Street and may not be continuous throughout the alignment.

Marine Clay and Sand – A heterogeneous 60- to 80-foot-thick layer of marine clay and sand is located beneath the fill and yellow clay. This layer is continuous throughout the alignment and occurs between 15 to 30 feet below ground surface.

Glacial Till – Glacial till lies beneath the marine clay and sand at a depth of about 90 feet below ground surface.

Bedrock – Bedrock is about 150 feet below ground surface (El. -25) near the north end of the alignment and about 100 feet below ground surface (El. 25) near the south end and of the alignment.

Groundwater levels in the upper aquifer along the alignment ranged between 5 and 30 feet below ground surface (El. 94 to El. 116). In general, the groundwater along the alignment appears to rise slightly in elevation from north to south. Groundwater levels in the lower aquifer will be measured as deep wells are installed for the Silver Line Phase III design.

4.8.3.3 Charles Street Alignment

The Charles Street Alignment runs approximately parallel to the former Shawmut Peninsula from the intersection of Boylston and Charles Streets south to approximately Fayette Street. At Fayette Street, the alignment turns east and heads back across the peninsula to Washington Street. Starting at the ground surface and proceeding downward, the subsurface profile along the alignment consists of the following:

Urban Fill – A 10- to 15-foot-thick layer of urban fill exists along the entire section of the alignment.

Stiff Yellow (Marine) Clay – A 10- to 15-foot thick layer of stiff yellow clay lies beneath the fill layer.

Marine Clay and Sand – A heterogeneous 50- to 80-foot-thick layer of marine clay and sand is located beneath the fill and yellow clay. This layer occurs about 25 feet below ground surface.

Glacial Till – Glacial till lies beneath the marine clay and sand at a depth of about 80 to 115 feet below ground surface.

Bedrock – Bedrock is about 85 feet below ground surface (El. 30) near the south end of the alignment and about 140 feet below ground surface (El. -25) near the north end of the alignment.

Groundwater levels in the upper aquifer along the alignment ranged between 8 to 12 feet below ground surface (El. 107 to El. 113). Groundwater levels in the lower aquifer will be measured as deep wells are installed for the Silver Line Phase III design.

4.8.3.4 Stuart Street Alignment

The Stuart Street alignment begins at the intersection Charles Street South and Boylston Street. From there, it runs south along Charles Street South to Stuart Street where it turns east until it reaches Tremont Street. At Tremont Street, the alignment turns south and follows the Tremont Street alignment. Except for a small section of the alignment located near the intersection of Charles Street South and Boylston Street, the alignment lies within the former Shawmut Peninsula. Starting at the ground surface and proceeding downward, the subsurface profile along the alignment consists of the following:

Urban Fill – A 3 to 20-foot-thick layer of urban fill exists along the entire section of the alignment.

Stiff Yellow (Marine) Clay – A 5- to 30-foot thick layer of stiff yellow clay lies beneath the fill. This layer appears to be continuous throughout the alignment.

Marine Clay and Sand – A heterogeneous 45- to 85-foot-thick layer of marine clay and sand is located beneath the fill and yellow clay. This layer occurs about 15 to 40 feet below ground surface and appears to be continuous throughout the alignment.

Glacial Till – Glacial till lies beneath the marine clay and sand at a depth of about 80 to 115 feet below ground surface.

Bedrock – Bedrock is about 80 to 130 feet below ground surface

4.8.3.5 Columbus Avenue Alignment

The Columbus Avenue Alignment extends southwest from about the intersection of Boylston and South Charles Streets until it surfaces west of Church Street. This alignment is in the Back Bay, west of the colonial shoreline, outside the former Shawmut Peninsula. Starting at the ground surface and proceeding downward, the subsurface profile along the alignment consists of the following:

Urban Fill – A 5- to 25-foot-thick layer of urban fill exists along the entire section of the alignment.

Organic Soil – A 5- to 25-foot-thick layer of organic soil lies below the fill. This layer appears below the fill south of Church Street does not appear to be continuous through the alignment.

Stiff Yellow (Marine) Clay - A 5- to 25-foot thick layer of stiff yellow clay lies beneath the fill layer and organic soil.

Marine Clay and Sand – A heterogeneous 60- to 75-foot-thick layer of marine clay and sand is located beneath the fill, organic soil, and yellow clay.

Glacial Till – A 25- to 40-foot-thick layer of glacial till lies beneath the marine clay and sand at a depth of about 100 feet below ground surface.

Bedrock – Bedrock is about 135 to 140 feet below ground surface (El. -20 to El. -25).

Groundwater levels in the upper aquifer along the alignment ranged between 10 and 20 feet below ground surface (El. 94 to El. 107). Groundwater levels in the lower aquifer will be measured as deep wells are installed for the Silver Line Phase III design.

4.9 Natural Resources

The Silver Line Phase III project is located primarily in a tunnel within downtown Boston and, except for Boston Common and the Boston Public Garden, the project area is densely developed with impervious surfaces such as streets, sidewalks and parking lots. There are no existing wetlands, floodplains, navigable waterways, or ecologically sensitive areas within the project corridor. (See Figure 4.9-1) A portion of the Phase III alignment on Essex Street between South Station and the underground Central Artery (Interstate 93) is located within the Coastal Zone.

The Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife (MassWildlife) and the United States Department of the Interior Fish and Wildlife Service were consulted for information regarding endangered and threatened species in the project area in accordance with the Massachusetts Endangered Species Act (M.G.L. c. 131A), and Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543). In their response letters, both agencies indicated that there is one species of federal and state concern near the project area, the Peregrine falcon (*Falco peregrinus*), which has nested on several downtown towers. (See Attachment C for a copy of this correspondence.) The Peregrine Falcon has been removed from the Federal endangered species list, but remains a state-listed endangered species in Massachusetts. The U.S. Fish and Wildlife Service, however, stated in their response that the Silver Line Phase III project is not anticipated to have impacts to the Peregrine falcon.

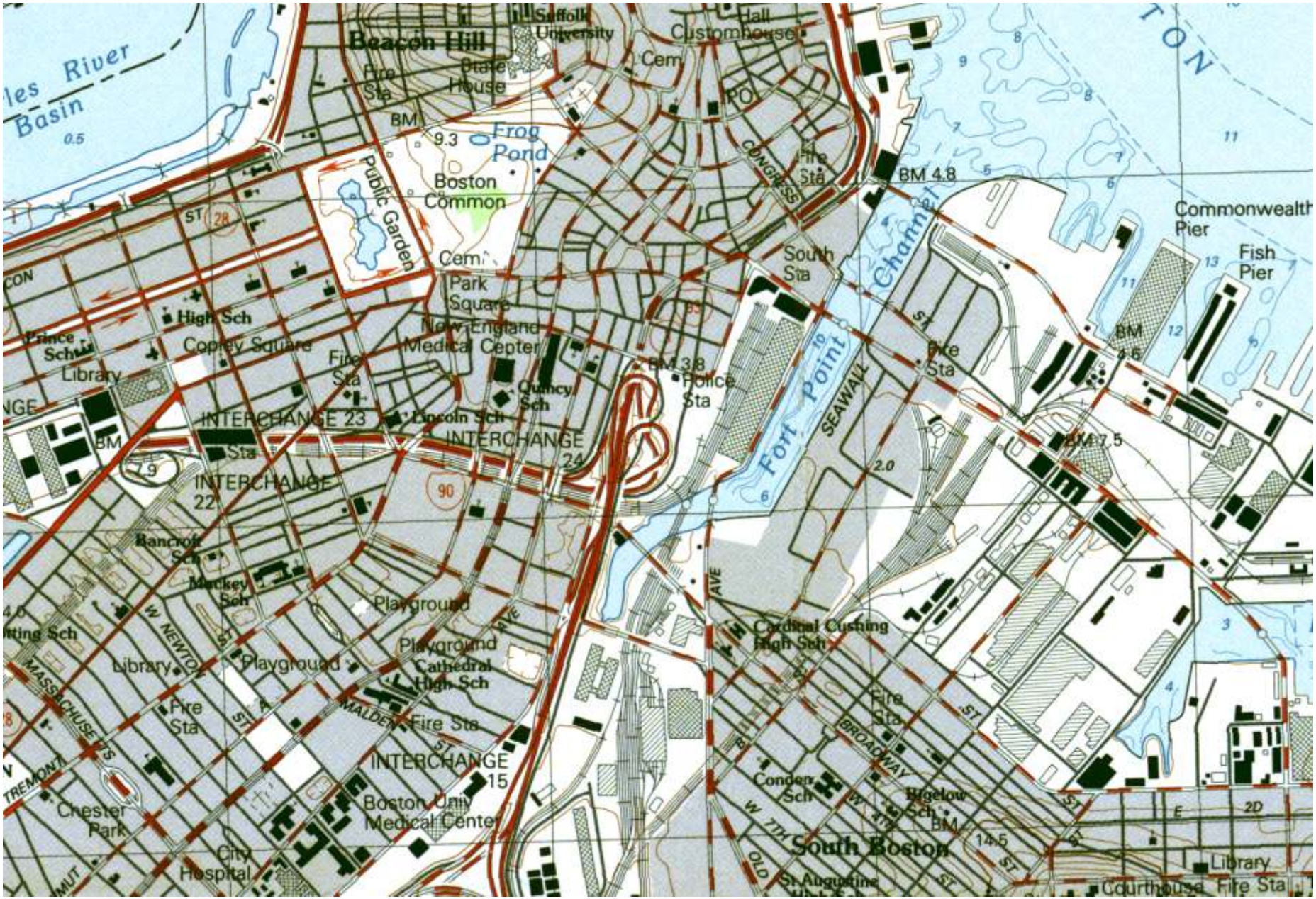
4.10 Historic and Archaeological Resources

This section describes the results of a cultural resources assessment undertaken for the Silver Line Phase III study area. The cultural resources assessment identified previously recorded historic and archaeological resources and provided recommendations regarding the expected locations and types of significant archaeological resources and identified historic resources requiring survey and/or evaluation. The study area, or area of potential effect (APE), for aboveground resources is either one building lot deep or within the viewshed of the alternatives. For belowground resources the study area includes locations along the alternatives where direct ground disturbances would occur for construction activities and permanent structures. A separate assessment was undertaken for the entire Boston Common to identify the locations and types of significant archaeological resources that could be affected by the project. Technical Appendix F contains the technical reports for these two studies. The Federal and State regulations that protect cultural resources are described in Section 5.10, where potential permanent impacts to these resources are identified.

4.10.1 Historic and Archaeological Contexts

4.10.1.1 Historic Context

The study area is densely built-up with a combination of historic commercial and residential building stock and modern infill. The existing streetscapes and patterns reflect the city's expansion from the late seventeenth century to the present. The early history and physical characteristics of the area were shaped by its geography, while later development was characterized by alteration of the topography (i.e., filling in marshlands) and often by dramatic reconfiguration of street patterns into the modern period.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.9-1
Natural Resources

Expansion of the city's Central Business District during the twentieth century has resulted in the alteration of the historic streetscapes of Essex, Boylston and Tremont Streets. On Essex Street, modern skyscrapers interrupt the horizontal character of the historic commercial blocks. Buildings have been demolished to accommodate the increased need for parking lots and parking garages. The demolition of buildings on corner lots has stripped the streetscape of the principal facades of the anchor buildings, thus leaving open areas and the unfinished side elevation of the adjacent buildings. These large voids have compromised the continuity and integrity of the commercial blocks. Several previously inventoried buildings on Tremont Street were demolished in the late twentieth century (MHC Forms 3000-5). Other disturbances to the study area include construction of the Central Artery, and the expansion of the New England Medical Center.

The Boston Common and Central Burying Ground on Boylston Street lie in the northwest corner of the study area. The Common was established in 1634, and is the oldest public park in the United States. The Central Burying Ground was established in 1756 at the south end of the Common. By 1835 the Public Garden had been created on filled land at the southwest corner of the Common to provide additional open space, and between about 1836 and 1840 the Common was transformed from pasture to a manicured park.

Prior to the 1800s, Boston Common abutted the brackish swamp known as Back Bay. Late eighteenth and early nineteenth century maps of Boston depict this area as shoreline with ropewalks located between the shoreline and Charles Street, just north of the Charles/Boylston Street intersection (Pelham 1775; Page 1775; Carlton 1795; Hales 1814). The nineteenth-century Pleasant Street corridor closely followed the shoreline contour of Boston at that time. By 1835-1836 some filling had taken place east of Charles Street in what was then called the "receiving basin." The Back Bay area had been designated for filling as part of Boston's plan for future expansion and development. The shoreline southwest of the Common had been shifted west of Pleasant Street and Church Street where a number of cross-streets had also been added; these are now part of the Bay Village Local Historic District.

The current alignment of Charles Street South follows the former route of Carver Street, which appears on maps of Boston as early as 1775. Carver Street extended south from Boylston Street to its intersection with Pleasant Street. This road configuration remained the same throughout the nineteenth to mid-twentieth century.

Late eighteenth through mid-twentieth century maps of the study area indicate numerous commercial, civic, institutional, transportation, and residential structures along these various streets that formed the urban quasi-grid street system south of Boston Common and the Public Garden. Only a handful of these buildings survive today, most having been razed since 1950 to make way for hotels, office buildings, and the State Transportation Building. During the second half of the twentieth century, this area was dramatically impacted by the Boston Redevelopment Authority (BRA) Park Plaza and South Cove urban renewal projects.

The Boston & Providence Railroad Depot, which contained several parallel tracks and large buildings, occupied the area currently bounded by Stuart Street to the south, Arlington Street to the west, Boylston Street to the north, and Charles Street to the east. The historic building and street configuration related to the railroad depot and transfer complex was present into the early twentieth century. The subsequent construction of the Park Plaza Hotel in 1925, the Motor Mart Garage in 1926-1927, and the Four Seasons Hotel obliterated the earlier historic period railroad building/streetscape. The remaining vestiges of the nineteenth and early twentieth-century buildings and streetscapes in this area include part of the Bay Village Local Historic District on Fayette, Melrose, and Jefferson Streets, and to the east of Charles Street at Lyndeboro Place; and on Warrenton Street.

The Park Plaza and South Cove Urban Renewal projects of the 1960s and 1970s resulted in the alteration of the historic streetscapes of Pleasant, Carver, Eliot, Tremont, and other streets in the study area. Modern skyscrapers interrupt the horizontal character of the historic commercial blocks, and buildings have been demolished to accommodate the increased need for parking lots

and parking garages. The demolition of buildings left open areas and unfinished side elevations of adjacent buildings leaving voids that compromise the continuity and integrity of the streetscapes.

4.10.1.2 Archaeological (Pre-Contact Period) Context

The study area is located at the southern end of the Shawmut Peninsula between the South Cove and the muddy tidal flats of Back Bay. This area is known to have been inhabited as early as the Late Archaic Period between 5000 and 2000 years before present (B.P.) through the Late Woodland and Contact periods (1000 to 300 B.P.). A number of pre-Contact Period sites have been recorded on the peninsula in what is now downtown Boston, including the neck or "slender stem" that provided the only land route connecting to the mainland and the former Back Bay tidal flats. A documented Contact Period native trail was routed along present-day Washington and Boylston streets. Two important prehistoric sites discovered in present-day Boston consist of the Block 79 Site (19-SU-61) at the southeast side of Boston Common and the Boylston Street Fishweir and associated fishweir remains (19-SU-16) between Boylston and Stuart streets, and Clarendon and Berkeley streets (MHC site files).

4.10.2 Methods of Data Collection

4.10.2.1 Historic

An historic resource survey of historic aboveground resources was undertaken along the Silver Line Alternative alignments. The survey consisted of research, field survey, and analysis. The aboveground resources project study area is either one building lot deep or encompasses the area within the potential viewshed of each alternative. Research included the Inventory of the Historic and Archaeological Assets of the Commonwealth and National Register files maintained by the Massachusetts Historical Commission as well as the files of the Boston Landmarks Commission (BLC). Numerous historic maps and plans of Boston were reviewed for information relating to changes in buildings, streetscapes, and topography within the project study area. Map sources include an online collection of late eighteenth and nineteenth century maps of Boston with modern street, major road, lake, and park GIS overlays and geospatial data (www.davidrumsey.com).

4.10.2.2 Archaeological

The project study area for belowground resources includes locations along the Core Tunnel Segment and four build alternatives where direct ground disturbances would occur for construction activities and permanent structures. The assessment for archaeological resources consisted primarily of archival research to identify known and expected sites. The background research described under the historic resources methodology was applied to the belowground resources assessment along with the more in-depth archival research pertaining directly to recorded archaeological resources. Additional archival sources included all previous archaeological studies and geo-technical articles within and surrounding Boston Common (Jones 1986; (Mrozowski et al. 1999, 2000; Newby and Webb 1994); Pendery 1985, 1987, 1988, 1992, 1993), which provided information about pre-contact, contact, and post-contact period cultural contexts and recorded sites in the project study area Citywide and Boston Common-specific histories about landmaking and land-use (Beaudry and Blosser 1981; Krieger and Cobb 1999; Seasholes 2003; Zaitevsky 1982), and historic maps and atlases were also consulted for information relating to the types of documented resources that could be present below the modern landscape

The analysis of archaeological site types and subsurface soil conditions in the project study area was supplemented with information obtained from currently available soil boring data and underground utility maps on file with the Boston City Engineer's Office. This information was used to provide a preliminarily assessment of the expected locations and types of significant archaeological resources that may be affected by the project.

4.10.3 Historic Aboveground Resources Existing Conditions

This section discusses the historic aboveground resources within the study area, or APE, for the Core Tunnel Segment, including the proposed Boylston and Chinatown stations, and four build alternatives. The assessment for historic resources included a literature study that collected information on historic properties that are designated in at least one of several categories as National Historic Landmarks, listed or eligible for listing in the National Register of Historic Places (National Register), Local Historic Districts, and Local Landmarks. The literature search also identified previously surveyed buildings with inventory forms on file at the Massachusetts Historical Commission without National Register eligibility determinations. Project mapping and a preliminary field reconnaissance survey was used to record historic resources that appear older than 50 years and that have not previously been surveyed. Resources are discussed below for the Core Tunnel Segment. Followed by each Alternative Alignment – Tremont Street, Charles Street, Stuart Street, and Columbus Avenue.

4.10.3.1 Core Tunnel Segment

The historic resources along the Core Tunnel Segment are listed in Table 4.10-1 and shown in Figure 4.10-1. The eastern end of the study area includes South Station, which is individually listed in the National Register. West of the Central Artery, the study area partially abuts the northern boundary of the Leather Historic District, which is listed in the National Register and was the center of the city's leather manufacturing and trade. The Textile Historic District on Essex Street is listed in the National Register and was the center of the city's textile industry. The district straddles Essex Street from Kingston Street to Harrison Avenue. Eleven contributing properties in the district are adjacent to the study area. The Boston Theater Multiple Resource Area includes several theaters and four distinct districts, all of which are listed in the National Register, and several Local Landmarks, that achieved their greatest significance as cultural and entertainment areas between the 1890s and 1930s. The Liberty Tree Historic District occupies a one-block section of Essex Street, from Washington Street to Harrison Avenue. At the corner of Washington and Essex Streets, is the Liberty Tree Building (1850), one of the earliest major commercial buildings remaining in the Theater District. The Washington Street Historic District is an entertainment cluster that includes the Savoy, Bijou, and Paramount theaters. The Piano Row Historic District is located along the south side of Boylston Street, between Tremont Street and Charles Street. Piano Row's cohesive streetscape composed of commercial buildings and one theater forms the architectural frame for the south end of the Boston Common.

The Tremont Street Subway was constructed in 1897. The active segment of the tunnel between Park and Boylston Streets used by the Green Line is individually listed in the National Register (MHC 1972) and is also a contributing component of the Boston Common National Historic Landmark. The abandoned southern extension of the Tremont Street Subway Tunnel, from Boylston at Tremont to Broadway Street, is considered eligible for the National Register as part of the original Tremont Street Subway system. The existing MBTA Boylston Station is within the study area. Boylston Station and associated surface head houses are contributing components to the Boston Common National Historic Landmark. The Boston Common, Central Burying Ground and Public Garden are in the northwest section of the study area. All three are National Historic Landmarks, Local Landmarks, and listed in the National Register. The Boston Common was established in 1634, making it the oldest public park in the United States, and the Central Burying Ground was established in 1756. By 1835 the Public Garden had been created on filled land at the southwest corner of the Common to provide additional open space.

The APE, or study area also includes the following individual properties. It encompasses six properties individually listed to the National Register and one individually National Register eligible property. Eight properties within the project study area have been designated Local Landmarks, and the BLC is evaluating the landmark status of one additional building. The survey also identified eight previously surveyed buildings without National Register eligibility determinations; and one monument that appear older than 50 years that has not been surveyed.

Table 4.10-1 – Historic Resources, Core Tunnel Segment, Silver Line Phase III Project

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
001	620	Atlantic Avenue		South Station	1896-1899		Head House 1507/Waiting Room 9003	NRIND	
002	687-695	Atlantic Avenue		Hotel Essex; Plymouth Rock Building	1899		BOS.1518	NRDIS	Leather
003	66-86	Lincoln Street	70-80 Lincoln Street	Lincoln Building; Lincoln Plaza	1894		BOS.1847	NRDIS	Leather
004	125	Essex Street	104-122 Kingston Street	Achmuty Building; Dainty Dot Hosiery	1889	AX	BOS.1819	NRDIS	Textile
005	88	Kingston Street		[Commercial Block]	1893		BOS.1818	NRDIS	Textile
006	105-107	Essex Street	129 Kingston Street, 2-12 Edinboro Street	Kingston Building	1888	AX	BOS.1711	NRDIS	Textile
007	80-82	Essex Street		[Commercial Block]	#80-ca. 1920-25: #82-1925	AX	BOS.1706	NRDIS	Textile
008	76-78	Essex Street		[Manufacturing Block]	1922	AX	BOS.1705	NRDIS	Textile
009	81-83	Essex Street		Pelham Building	1900	AX	BOS.1709	NRDIS	Textile
010	73-79	Essex Street	208 Oxford Street	Joy Langdon Co.; Simons, Hatch & Whitten Co.	1907	AX	BOS.1708	NRDIS	Textile
011	62-72	Essex Street	102-116 Chauncy Street	[Manufacturing Block]	1899	AX	BOS.1704	NRDIS	Textile
012	2-8	Harrison Avenue	59-71 Essex Street/1-13 Oxford Street	Verizon N. E. Telephone Co.	1920		BOS.1772	No Eval.	
013	50	Essex Street	115-17 Chauncey Street	Wendell Phillips Office Building	1921		BOS.1655	NRDIS	Textile
014	41-45	Essex Street	1-5 Harrison Avenue	Kelley, Samuel D. Tenement Building	1886		BOS.12836	No Eval.	
015	588-622	Washington Street			c. 1900		BOS.9014	No Eval.	
016	25-31	Essex Street		Essex Hotel	c. 1881	BM, BO	BOS.2267	NRDIS, NRMRA	Liberty Tree, Boston Theater Area
017	15-17	Essex Street		[Commercial Block]	1875	BM, BO	BOS.2265	NRDIS, NRMRA	Liberty Tree, Boston Theater Area

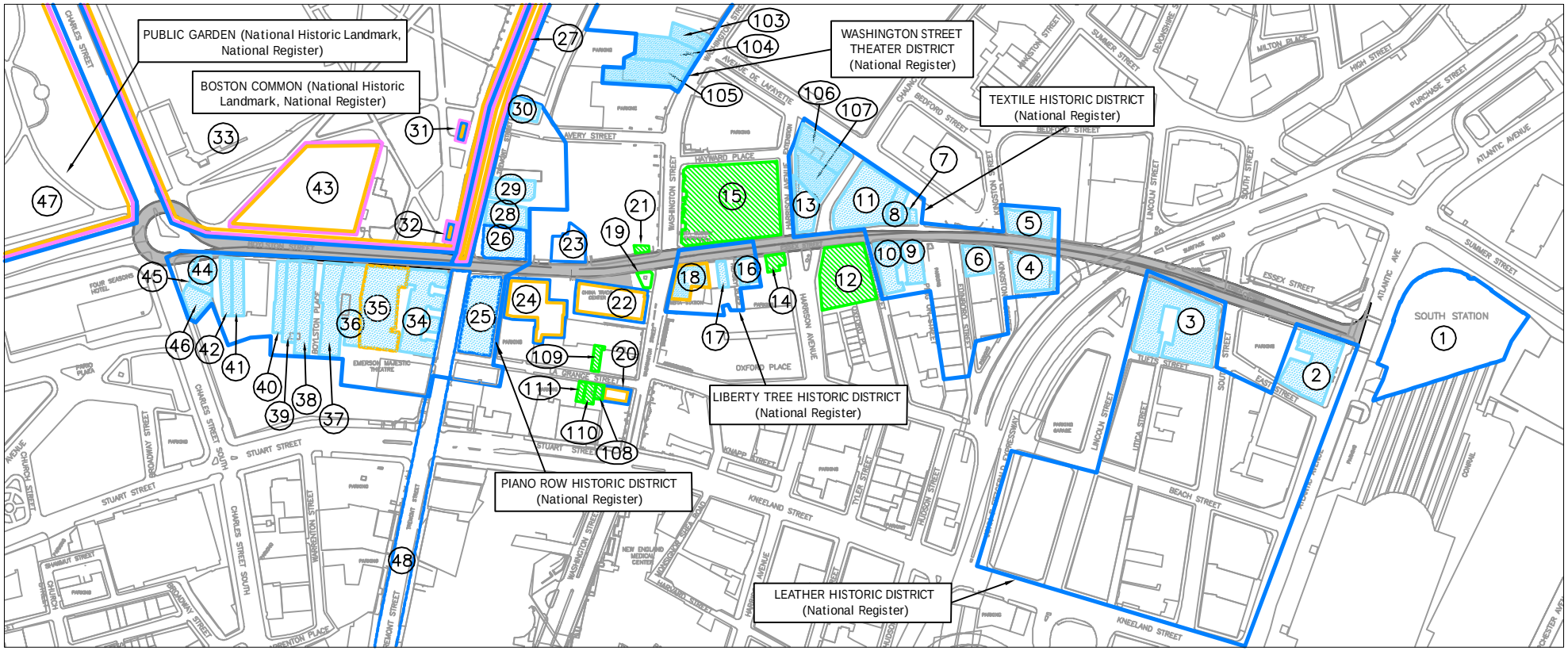
Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
018	628-636	Washington Street	1-9 Essex Street	Liberty Tree Block & Union Hall	1850		BOS.2332	LL, NRDIS, NRMRA	Liberty Tree, Boston Theater Area
019		Essex Street		Liberty Tree Plaque/Monument				No Survey	
020	681-683	Washington Street		Hayden Building (Cathay Bank)	1875	BL/BM; BO		NRIND, LL, NRMRA, PR	Boston Theater Area
021		Washington Street at Boylston Street at Essex		Essex Station	1908		BOS.9012	No Eval.	
022	2-22	Boylston Street	651-657 Washington Street	Boylston Building (China Trade Center)	1887	BO	BOS.2245	NRIND, LL, NRMRA	Boston Theater Area
023	25-39	Boylston Street		Boston Edison Electric Illuminating Company	1906	BO	BOS.2246	NRIND, NRMRA	Boston Theater Area
024	48-52	Boylston Street		Boston Young Men's Christian Union	1851	BO	BOS.2247	NRIND, LL	
025	62	Boylston Street		Hotel Touraine	c. 1900	BL	BOS.2248	Ind. NR Elig., NRDIS, NRMRA	Piano Row, Boston Theater Area
026	183-186	Tremont Street	51-53 Boylston Street	Grand Lodge of Masons	c. 1900	BL	BOS.2309	Ind. NR Elig., NRDIS, NRMRA	Piano Row, Boston Theater Area
027		Tremont Street		Tremont Street Subway Tunnel	1897			NHL, NRIND, LL, NRDIS	Tremont Street Subway: Boston Common
028	180-182	Tremont Street		Boston Edison Electric	1931	BL	BOS.2308	NRDIS, NRMRA	Piano Row, Boston Theater Area
029	178-179	Tremont Street		Oliver Ditson Building	1917	BL	BOS.2307	NRDIS, NRMRA	Piano Row, Boston Theater Area
030	28-30	Avery Street		Boston Music Company	1914 façade on 1874		BOS.2237	NRDIS, NRMRA	Piano Row, Boston Theater Area
031		Tremont Street		Tremont Street Subway Station Head Houses	1897		BOS.9011	NHL, LL, NRDIS	Tremont Street Subway, Boston Common

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
032		Boylston and Tremont Streets		Boylston Street Subway Station	1897		BOS.9009	NHL, LL, NRDIS	Tremont Street Subway, Boston Common
033	N/A	Boylston Street	Beacon, Park, Tremont, and Charles Streets	Boston Common	1634	AZ; BA		NHL, LL, NRDIS	Boston Common, Boston Common and Public Garden
034	74-94	Boylston Street	195-215 Tremont Street	Pelham Building; Little Building	1915-1917	BL; BO	BOS.2249	NRDIS, NRMRA	Boston Theater Area, Piano Row
035	96-106	Boylston Street		Colonial Building; Colonial Theater	1899-1900	BL; BO	BOS.2250	LLP, NRDIS, NRMRA	Boston Theater Area, Piano Row
036	114-116	Boylston Street		Walker Building; S.S. White Dental Co.	1891-1893	BL; BO	BOS.2251	NRDIS, NRMRA	Boston Theater Area, Piano Row
037	120-124	Boylston Street		Walker Building Addition	1901	BL; BO	BOS.2252	NRDIS, NRMRA, PR	Boston Theater Area, Piano Row
038	130-132	Boylston Street		Ginter Building - 1930s Tucker Building - 1940s	1889-1890	BL; BO	BOS.2253	NRDIS, NRMRA	Boston Theater Area, Piano Row
039	134-136	Boylston Street		[Unknown]	1890-1895	BL; BO	BOS.2254	NRDIS, NRMRA	Boston Theater Area, Piano Row
040	138-140	Boylston Street		S.S. White Dental Co.	1897	BL; BO	BOS.2255	NRDIS, NRMRA	Boston Theater Area, Piano Row
041	158-160	Boylston Street		Vose Building	1899	BL; BO	BOS.2259	NRDIS, NRMRA	Boston Theater Area, Piano Row
042	162	Boylston Street		Steinert, M. and Sons Musical Company Building	1896	BL; BO	BOS.2260	NRDIS, NRMRA	Boston Theater Area, Piano Row
043	N/A	Boylston Street		Central Burying Ground	Est. 1754	AZ; BA	BOS.804	NHL, LL, NRDIS, PR	Boston Common, Boston Common and Public Garden
044	2	Park Square (Charles Street)	176A Boylston	Boylston Street Florist; L.J. Peretti Tobacconist	1889	BL; BO	BOS.2287	NRDIS, NRMRA	Boston Theater Area, Piano Row
045	3	Park Square (Charles Street)		The Trolley Stop	1890-1895	BL; BO	BOS.2288	NRDIS, NRMRA	Boston Theater Area, Piano Row
046	4	Park Square (Charles Street)		Isóle	1890-1895	BL; BO	BOS.2289	NRDIS, NRMRA	Boston Theater Area, Piano Row
047	N/A	Charles Street	Arlington; Boylston; Park	Boston Public Garden	1859	BA; BB		NHL, LL, NRDIS	Boston Public Garden, Boston Common and Public Garden
048		Tremont Street at Boylston Street		Tremont Street Tunnel South Extension	1897		BOS.9010	NR Elig.	Tremont St. Subway

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
103	539	Washington Street		Savoy Theatre/B.F. Kieth Memorial	1925-1928	BL/BM; BO	BOS.2326	NRDIS, NRMRA, LL, PR	Washington Street Theater, Boston Theater Area
104	543-547	Washington Street		Amusement Center/Adams House/Bijou Theatre	1858-1860	BL/BM; BO	BOS.2327	NRDIS, NRMRA	Washington Street Theater, Boston Theater Area
105	549-563	Washington Street		Paramount Theatre	1930-1932	BL/BM; BO	BOS.2328	NRDIS, NRMRA, LL	Washington Street Theater, Boston Theater Area
106	89-99	Chauncy Street	7 Exeter Place; 21-29 Harrison Avenue	The Textile Building	1917	BI/BM; AX	BOS.1623	NRDIS	Textile
107	105-111	Chauncy Street	11-19 Harrison Avenue	Frost Building	1902	BL/BM; AX	BOS.1624	NRDIS	Textile
108	12	LaGrange Street			1830-1840	BL/BM; BO	BOS.2281	No Eval.	
109	15-17	LaGrange Street			1830-1840	BL/BM; BO	BOS.2282	No Eval.	
110	18	LaGrange Street			1830-1840	BL/BM; BO	BOS.2283	No Eval.	
111	20-22	LaGrange Street			1916	BL/BM; BO	BOS.2284	No Eval.	

*MHC Area Key
AX = Wholesale District
AZ/BA/BB = Boston Common and Public Garden
BL/BM = Central Business District
BO = Theater District
BQ = Bay Village Historic District
BS = Lyndeboro Place Area
BT = Back Bay Historic/Architectural District

**Status Key
Ind. NR Elig. = Individually National Register Eligible
LHD = Local Historic District
LL = Local Landmark/Boston Landmark
LLP = Local Landmark Pending
NHL = National Historic Landmark
NRDIS = National Register District
NR Elig. = Eligible for the National Register as part of the Tremont Subway Historic District
NRIND = Individual National Register Property
NRMRA = National Register Multiple Resource Area
PR = Preservation Restriction
No Eval. = Surveyed property without evaluation
No Survey = Property not previously No Surveyed



LEGEND

- (68) *Historic Resource Number*
- *National Historic Landmark*
- *National Register Historic District Boundary or Individual Property Footprint*
- *National Register Historic District - Contributing*
- *National Register Eligible - Individual Property*
- *Local Landmark Listed - District Boundary or Individual Property Footprint*
- *Local Landmark - Pending*
- *Individual Property Footprint - Surveyed Without National Register Evaluation*
- *Individual Property Footprint - Not Previously Surveyed*

TREMONT STREET SUBWAY TUNNEL and KIOSKS (27) (31) (32)

- *National Historic Landmark*
- *National Register Historic District (Boston Common) and National Register Individual*
- *Local Landmark*

N

0 100 250 500ft

0 50 100 150m

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.10-1
Historic Resources - Core Tunnel Segment

4.10.3.2 Tremont Street Alternative

The area of potential effect for the Tremont Street Alternative includes the Piano Row Historic District along the northern portion of Tremont Street (see Table 4.10-2 and Figure 4.10-2). In addition to the various resources along Boylston Street, the Emerson Majestic Theater and Union Savings Bank Building are located along Tremont Street. Moving south, there are five buildings that appear to be more than 50 years old and that have not been surveyed, and seven structures that have been surveyed but not evaluated for the National Register. The Wilbur Theater and Wang Theater, both National Register listed and Local Landmarks are within the Boston Theater Multiple Resource Area.

As indicated in the previous section, the abandoned southern extension of the Tremont Street Subway Tunnel is eligible for the National Register. In the late 1960s the southern portion of the tunnel at the incline where the surface streetcar lines enter the tunnel was filled in for the construction of the Church of All Nations.

4.10.3.3 Charles Street Alternative

The area of potential effect for the Charles Street Alternative (see Table 4.10-3 and Figure 4.10-3) encompasses the Boston Theater Multiple Resource Area, two individually listed National Register properties, the Charles Street Playhouse and the Shubert Theater. The study area also includes part of the Bay Village Local Historic District. The survey identified four buildings that appear to be more than 50 years old and that have not been surveyed, and nine buildings and one local historic district that have been previously surveyed but not evaluated for the National Register.

The abandoned southern extension of the Tremont Street Subway Tunnel discussed above is also within this area.

4.10.3.4 Stuart Street Alternative

The Stuart Street Alternative (see Table 4.10-4 and Figure 4.10-4) includes the Boston Theater Multiple Resource Area. The project study area includes three properties individually listed in the National Register, the Wilbur Theater, the Wang Theater, and the Schubert Theater, as well as one individual National Register-eligible property, the Motor Mart Garage. The Wilbur Theater and Wang Theater are also Local Landmarks. The survey identified four buildings that appear to be more than 50 years old and that have not been surveyed, and four buildings that have been previously surveyed but not evaluated for the National Register.

The abandoned southern extension of the Tremont Street Subway Tunnel discussed above is also within this area.

4.10.3.5 Columbus Avenue Alternative

The Columbus Avenue Alternative (see Table 4.10-5 and Figure 4.10-5) includes the Boston Theater Multiple Resource Area. The study area includes three properties individually listed in the National Register, the Paine Furniture Building, the 1st Corps of Cadets Armory, and 195-215 Columbus Avenue, as well as one individual National Register-eligible property, the Motor Mart Garage. The BLC has designated one property within the project study area as a Local Landmark (the 1st Corps of Cadets Armory) and is evaluating the landmark status of one additional property, the Paine Furniture Building, 75-81 Arlington Street. The study area also includes part of the Bay Village Local Historic District. The survey also identified thirteen previously surveyed buildings without National Register eligibility determinations, and ten properties that appear older than 50 years that have not been surveyed.

Table 4-10.2 – Historic Resources, Tremont Street Alternative, Silver Line Phase III Project

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
048		Tremont Street at Boylston Street		Tremont Street Tunnel South Extension	1897		BOS.9010	NR Elig.	Tremont St. Subway
049	216-218	Tremont Street	115 LaGrange Street	Union Savings Bank Building	1925	BL, BO	BOS.2310	NRDIS, NRMRA	Piano Row, Boston Theater Area
050	219-221	Tremont Street		Saxon Theater; Emerson Majestic Theater	1901-1903	BL, BO	BOS.2311	LL, NRDIS, NRMRA	Piano Row, Boston Theater Area
051	220-222	Tremont Street			present façade 1890-95		BOS.2312	No Eval.	
052	224	Tremont Street			c. 1900		BOS.2313	No Eval.	
053	226	Tremont Street			1890-1895		BOS.2313	No Eval.	
054	228	Tremont Street			c. 1900			No Survey	
055	232	Tremont Street			c. 1900			No Survey	
056	236	Tremont Street			Early 20th century			No Survey	
057	154	Stuart Street		New England School of Law	c. 1920s			No Survey	
058	94-102	Warrenton Street		Stevens-Locke Co. Plumbing Supply Building	1905		BOS.2321	No Eval.	
059	90	Warrenton Street		Hotel Hampton	1885		BOS.2320	No Eval.	
060	244-248	Tremont Street		Wilbur Theater	1913-1914	BO	BOS.2314	LL, NRIND, NRMRA	Boston Theater Area
061	252-272	Tremont Street		Wang Theater and NEMC Outpatient Building	1925	BO	BOS.2315	NRIND, LL, NRMRA	Boston Theater Area
062	253-261	Tremont Street		Alsie's Stage Bar	1926		BOS.2316	No Eval.	
063	263-265	Tremont Street		Schubert Theater	1908-1910	BO	BOS.2317	NRIND, NRMRA	Boston Theater Area
064	271-279	Tremont Street		Bradford Hotel; B.P.O.E. #10	1925-1926		BOS.2318	No Eval.	
065	300	Tremont Street	821 Washington Street	Don Bosco School; Double Tree Hotel	c. 1925, 2000			No Survey	

For MHC Area and Status Keys see Table 4.10-1.

Table 4.10-3 – Historic Resources, Charles Street Alignment, Silver Line Phase III Project

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
048		Tremont Street at Boylston Street		Tremont Street Tunnel South Extension	1897		BOS.9010	NR Elig.	Tremont St. Subway
057	154	Stuart Street		New England School of Law	c. 1920s			No Survey	
058	94-102	Warrenton Street		Stevens-Locke Co. Plumbing Supply Building	1905		BOS.2321	No Eval.	
059	90	Warrenton Street		Hotel Hampton	1885		BOS.2320	No Eval.	
062	253-261	Tremont Street		Alsie's Stage Bar	1926		BOS.2316	No Eval.	
063	263-265	Tremont Street		Schubert Theater	1908-1910	BO	BOS.2317	NRIND, NRMRA	Boston Theater Area
064	271-279	Tremont Street		Bradford Hotel; B.P.O.E. #10	1925-1926		BOS.2318	No Eval.	
065	300	Tremont Street	821 Washington Street	Don Bosco School; Double Tree Hotel	c. 1925, 2000			No Survey	
066	60-72	Eliot Street	11-29 Broadway Street; 4-20 Columbus Avenue; 201-401 Stuart Street	Motor Mart Garage	1926-1927		BOS.2380	Ind. NR Elig.	
067	58	Charles Street South		N/A	1890s		BOS.2261	No Eval.	
068	60	Charles Street South		N/A	1890s		BOS.2261	No Eval.	
069	70-74	Charles Street South		Boston Edison Substation	1923		BOS.2262	No Eval.	
070	76-82	Charles Street South		Hotel Sumner	76-80, 187782, 1895		BOS.2263	No Eval.	
071	76-78	Warrenton Street		5th Universalist Church; Charles Playhouse	1838-1839	BO	BOS.2319	NRIND, NRMRA	Boston Theater Area

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
072	95-97	Broadway Street		[Unknown]	1940s-1950s	BQ		No Survey	Bay Village Local Historic District
073	99	Broadway Street		[Dwelling]	Mid 19th cent.	BQ		No Survey	Bay Village Local Historic District
074	115	Broadway Street		Boston Chinese Church of Saving Grace	1934	BQ		No Eval.	Bay Village Local Historic District
075	1+3	Lyndeboro Place		[Dwelling]	c. 1840	BQ; BS		LHD	Bay Village Local Historic District
076	2+4	Lyndeboro Place		[Dwelling]	c. 1840	BQ; BS		LHD	Bay Village Local Historic District

For MHC Area and Status Keys see Table 4.10-1.

Table 4-10-4 – Historic Resources, Stuart Street Alignment, Silver Line Phase III Project

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
048		Tremont Street at Boylston Street		Tremont Street Tunnel South Extension	1897		BOS.9010	NR Elig.	Tremont St. Subway
055	232	Tremont Street			c. 1900			No Survey	
056	236	Tremont Street			Early 20th century			No Survey	
057	154	Stuart Street		New England School of Law	c. 1920s			No Survey	
058	94-102	Warrenton Street		Stevens-Locke Co. Plumbing Supply Building	1905		BOS.2321	No Eval.	
059	90	Warrenton Street		Hotel Hampton	1885		BOS.2320	No Eval.	
060	244-248	Tremont Street		Wilbur Theater	1913-1914	BO	BOS.2314	LL, NRIND, NRMRA	Boston Theater Area
061	252-272	Tremont Street		Wang Theater and NEMC Outpatient Building	1925	BO	BOS.2315	NRIND, LL, NRMRA	Boston Theater Area
062	253-261	Tremont Street		Alsie's Stage Bar	1926		BOS.2316	No Eval.	
063	263-265	Tremont Street		Schubert Theater	1908-1910	BO	BOS.2317	NRIND, NRMRA	Boston Theater Area
064	271-279	Tremont Street		Bradford Hotel; B.P.O.E. #10	1925-1926		BOS.2318	No Eval.	
065	300	Tremont Street	821 Washington Street	Don Bosco School; Double Tree Hotel	c. 1925, 2000			No Survey	
066	60-72	Eliot Street	11-29 Broadway Street; 4-20 Columbus Avenue; 201-401 Stuart Street	Motor Mart Garage	1926-1927		BOS.2380	Ind. NR Elig.	

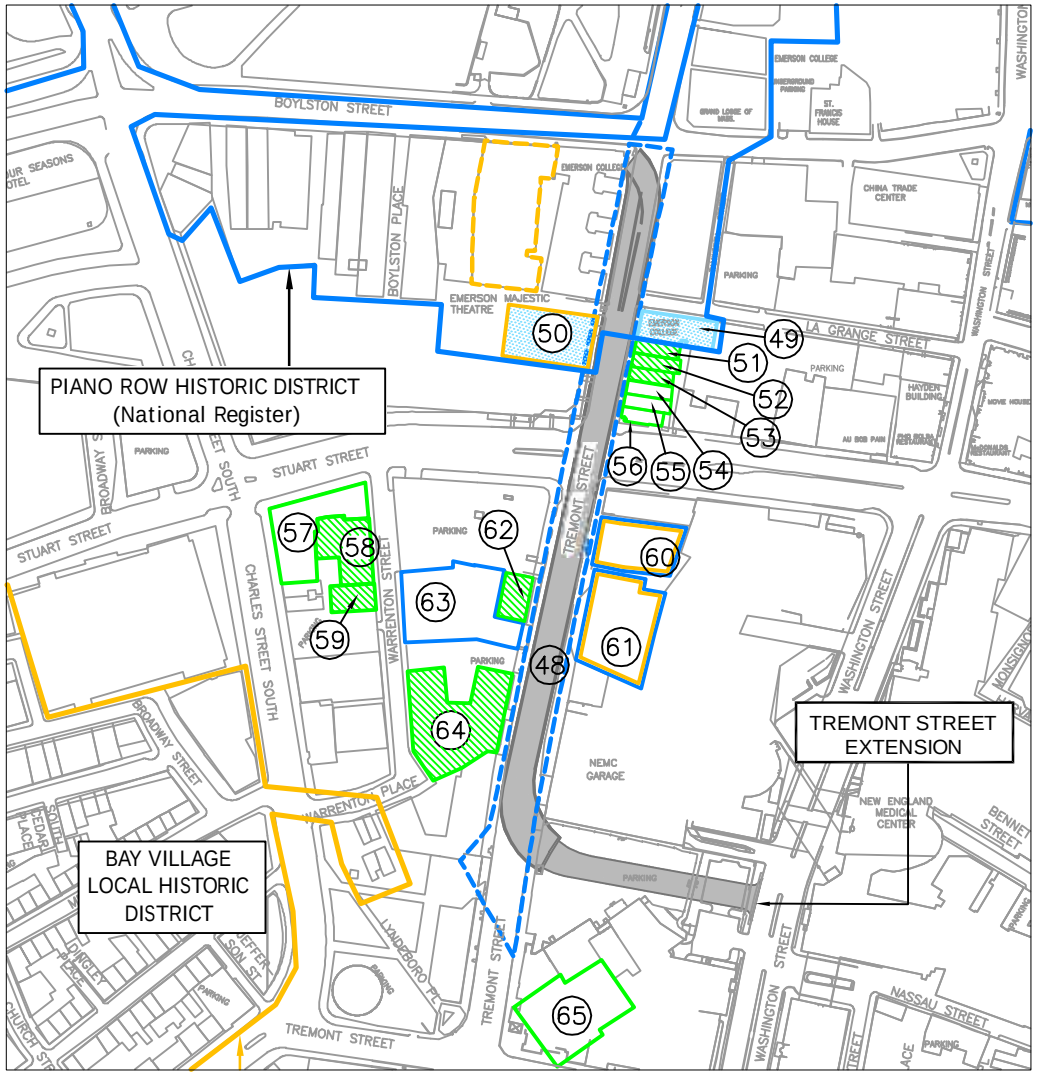
For MHC Area and Status Keys see Table 4.10-1.

Table 4.10-5 – Historic Resources, Columbus Avenue Alignment, Silver Line Phase III Project

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
066	60-72	Eliot Street	11-29 Broadway Street; 4-20 Columbus Avenue; 201-401 Stuart Street	Motor Mart Garage	1926-1927		BOS.2380	Ind. NR Elig.	
077	N/A	Eliot	Providence; Columbus	Emancipation Group	1879		BOS.9013	No Eval.	
078	54-78	Arlington	9-61 Columbus; 10-56 Providence	Park Plaza Hotel & Towers/Statler Office Building & Hotel	1925		BOS.2359	No Eval.	
079	244-250	Boylston	23-29 Providence	Garden Building	1911		BOS.2365	No Eval.	
080	212	Stuart Street		Jae's	1939			No Survey	Bay Village Local Historic District
081	16	Shawmut Street		Attached Row Houses	1840s	BQ		No Survey	Bay Village Local Historic District
082	18	Shawmut Street		Attached Row Houses	1840s	BQ		No Survey	Bay Village Local Historic District
083	22	Shawmut Street		Attached Row Houses	1840s	BQ		No Survey	Bay Village Local Historic District
084	28	Shawmut Street		Attached Row Houses	1840s	BQ		No Survey	Bay Village Local Historic District
085	69	Church		Storefront	1910s-1920s	BQ		No Survey	Bay Village Local Historic District
086	100	Arlington	250 Stuart	Consolidated Gas Company Building	1927		BOS.2361	No Eval.	
087	75-81	Arlington	301-305 Stuart; 2-6 St. James	Paine Furniture Building	1913		BOS.2360	NRIND, LLP	
088	130	Columbus Avenue	97-105 Arlington	1st Corps of Cadets Armory	1891-1897		BOS.2371	NRIND, LL	

Map #	Number	Street Name	Other Address	Historic Name/Function	Date Constructed	MHC Area*	MHC #	Status**	Historic District
089	129-133	Columbus Avenue	304-306 Stuart	[No name]	1913-1914			No Eval.	
090	135-137	Columbus Avenue	310-312 Stuart	[No name]	c. 1881-1882; Oct-1919 Facades			No Eval.	
091	139-145	Columbus Avenue	314-316 Stuart	[No name]	1881			No Eval.	
092	147-153	Columbus Avenue	320-322 Stuart	[No name]	1881			No Eval.	
093	162-172	Columbus Avenue		Carter's Ink Factory	1883			No Eval.	
094	330	Stuart Street	155 Berkeley	Salada Tea Building/Berkeley Place	1916-1926 (addition)		BOS.2392	No Eval.	
095	200	Columbus Avenue		Ladder 17 Engine 7 District 4 Fire Station	1970	BQ	BOS.2378	No Eval.	Bay Village Local Historic District
096	187	Columbus Avenue	Berkeley Street	Salvation Army State Headquarters	1950		BOS.2376	No Eval.	
097	34	Isabella Street		N/A	Late 19th Century	BQ		No Survey	Bay Village Local Historic District
098	23	Cortes Street		N/A	Late 19th Century	BQ		No Survey	Bay Village Local Historic District
099	25	Cortes Street	40 Isabella Street	Hotel Clifford	1876	BQ		LHD	Bay Village Local Historic District
100	119	Columbus Avenue	Berkeley Street	Rowhouse	Late 19th Century	BQ		No Survey	Bay Village Local Historic District
101	195-215	Columbus Avenue	140-144 Berkeley Street	Pledge of Allegiance Building/Youth's Companion Building	1880-1882		BOS.2377	NRIND	
102		Columbus Avenue	Church Street; Stuart Street	Statler Park and Fountain	c. 1925			No Survey	

For MHC Area and Status Keys see Table 4.10-1.



LEGEND

- 68 — Historic Resource Number
- National Historic Landmark
- National Register Historic District Boundary or Individual Property Footprint
- National Register Historic District - Contributing
- National Register Eligible - Individual Property
- Local Landmark Listed - District Boundary or Individual Property Footprint
- Local Landmark - Pending
- Individual Property Footprint - Surveyed Without National Register Evaluation
- Individual Property Footprint - Not Previously Surveyed

N

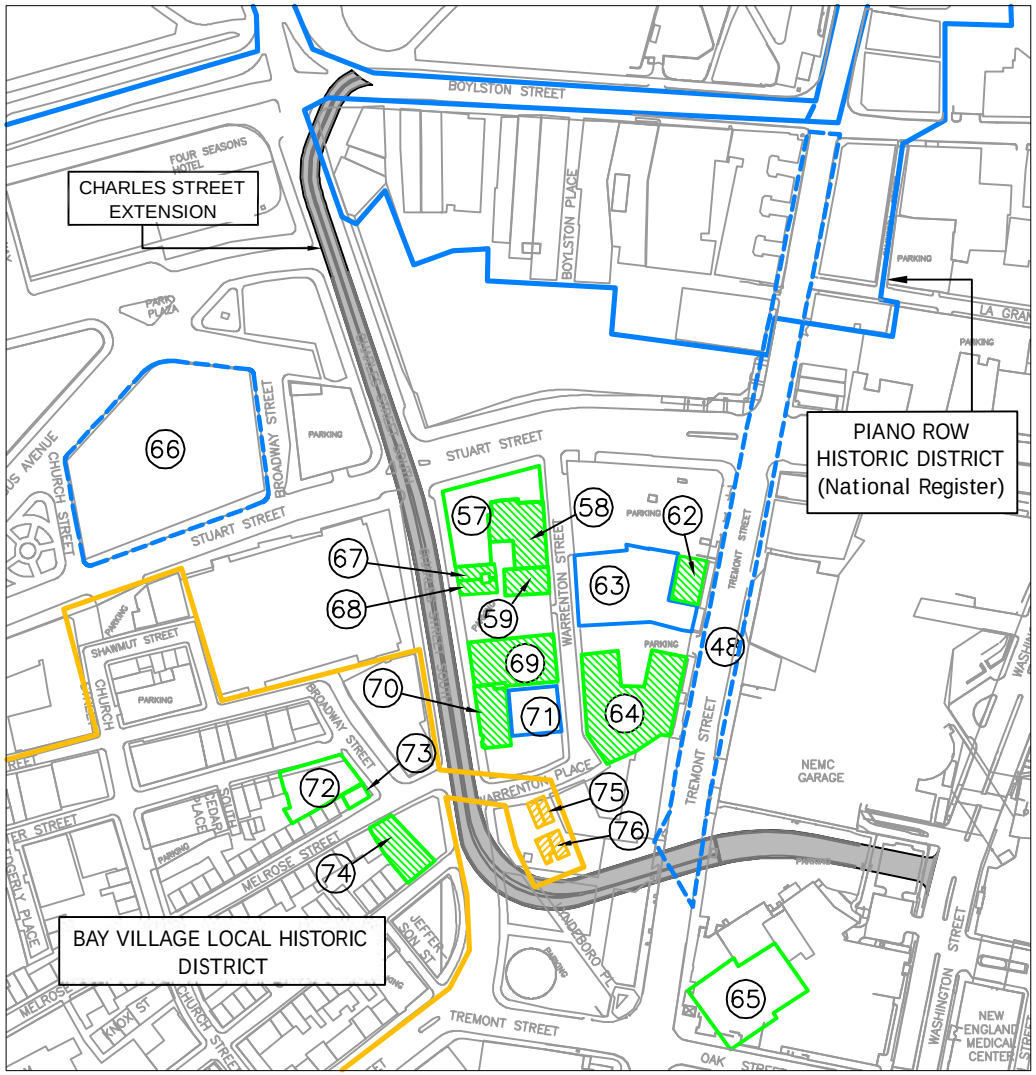
0 100 250 500ft

0 50 100 150m

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.10-2
Historic Resources - Tremont Street Alignment



LEGEND

- 68 — Historic Resource Number
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- National Register Historic District - Contributing
- National Register Eligible - Individual Property
- Local Landmark Listed - District Boundary or Individual Property Footprint
- Local Landmark - Pending
- Individual Property Footprint - Surveyed Without National Register Evaluation
- Individual Property Footprint - Not Previously Surveyed

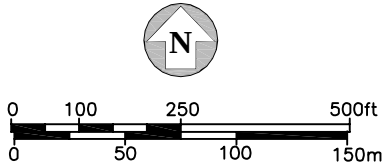
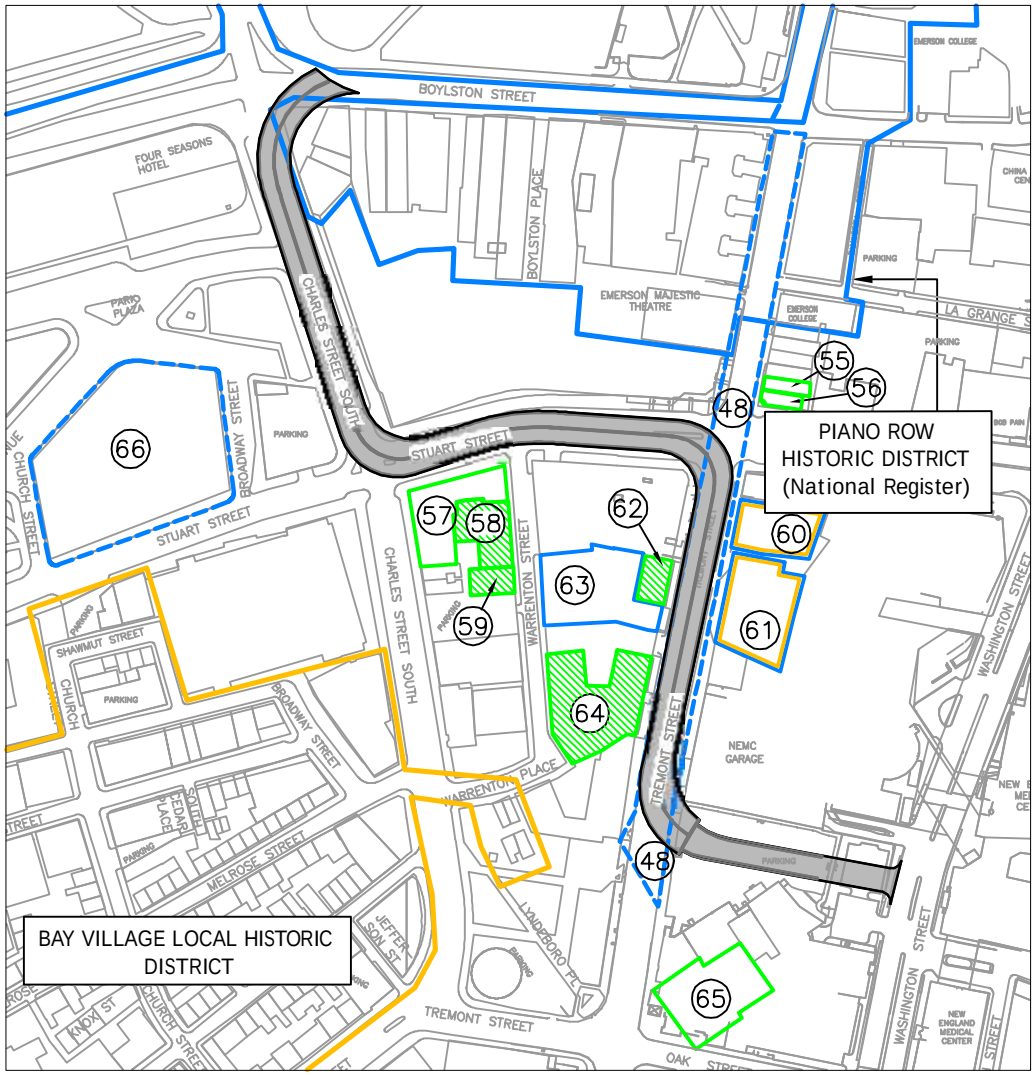


Figure 4.10-3
Historic Resources - Charles Street Alignment



LEGEND

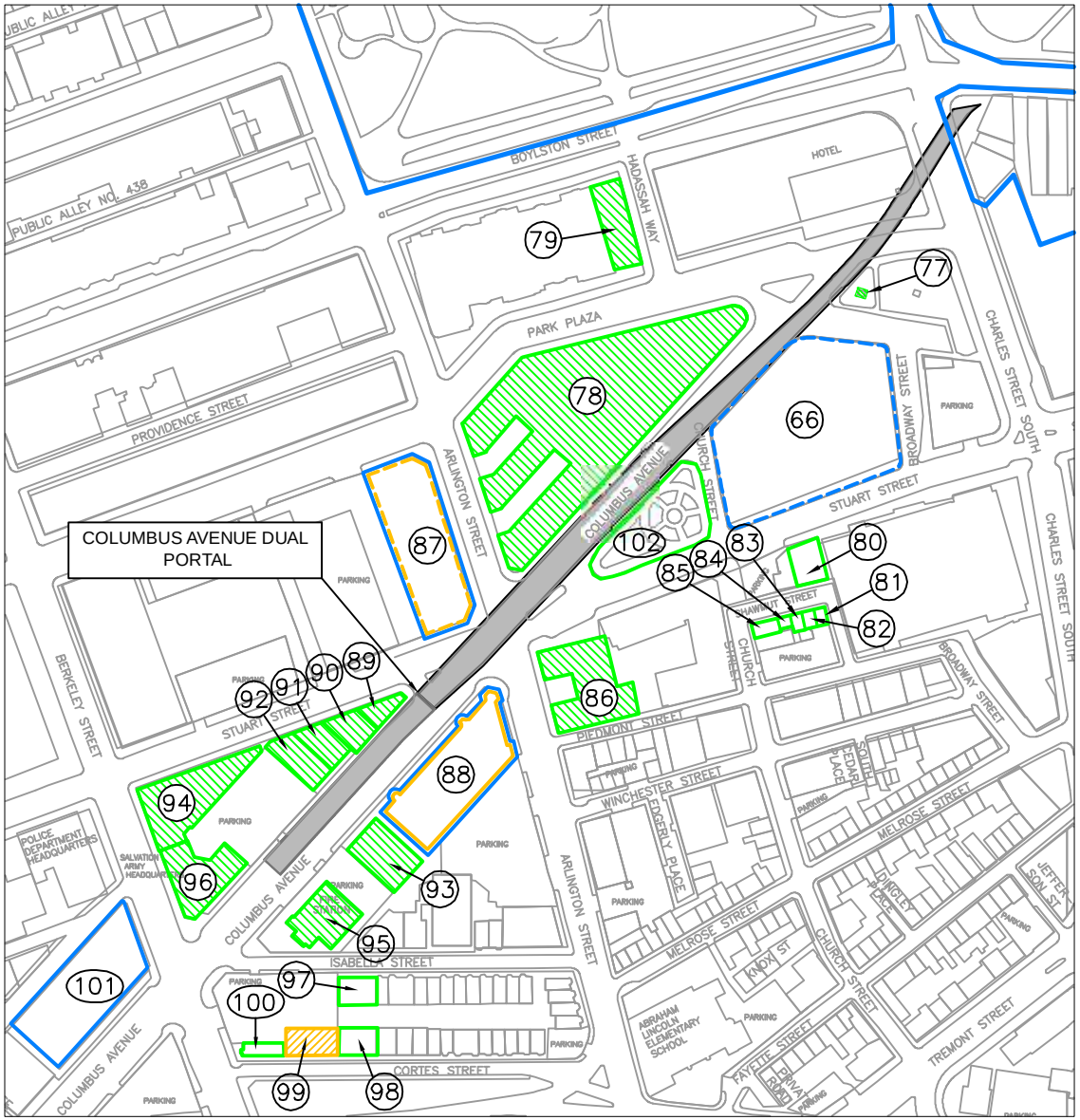
- 68 — Historic Resource Number
- National Historic Landmark
- National Register Historic District Boundary or Individual Property Footprint
- National Register Historic District - Contributing
- National Register Eligible - Individual Property
- Local Landmark Listed - District Boundary or Individual Property Footprint
- Local Landmark - Pending
- Individual Property Footprint - Surveyed Without National Register Evaluation
- Individual Property Footprint - Not Previously Surveyed

N

0 100 250 500ft

0 50 100 150m

Figure 4.10-4
Historic Resources - Stuart Street Alignment



LEGEND

- 68 — Historic Resource Number
- National Historic Landmark
- National Register Historic District Boundary or Individual Property Footprint
- National Register Historic District - Contributing
- National Register Eligible - Individual Property
- Local Landmark Listed - District Boundary or Individual Property Footprint
- Local Landmark - Pending
- Individual Property Footprint - Surveyed Without National Register Evaluation
- Individual Property Footprint - Not Previously Surveyed

N

0 100 250 500ft

0 50 100 150m

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.10-5
Historic Resources - Columbus Avenue Alignment

4.10.4 Existing Archaeological Conditions

The description of known and expected significant archaeological resources is first provided for the Core Tunnel Segment, followed by each alignment alternative – Tremont Street, Charles Street, Stuart Street, and Columbus Avenue. The archaeological sensitivity of the entire study area is shown in Figures 4.10-6 through 4.10-10.

4.10.4.1 Core Tunnel Segment

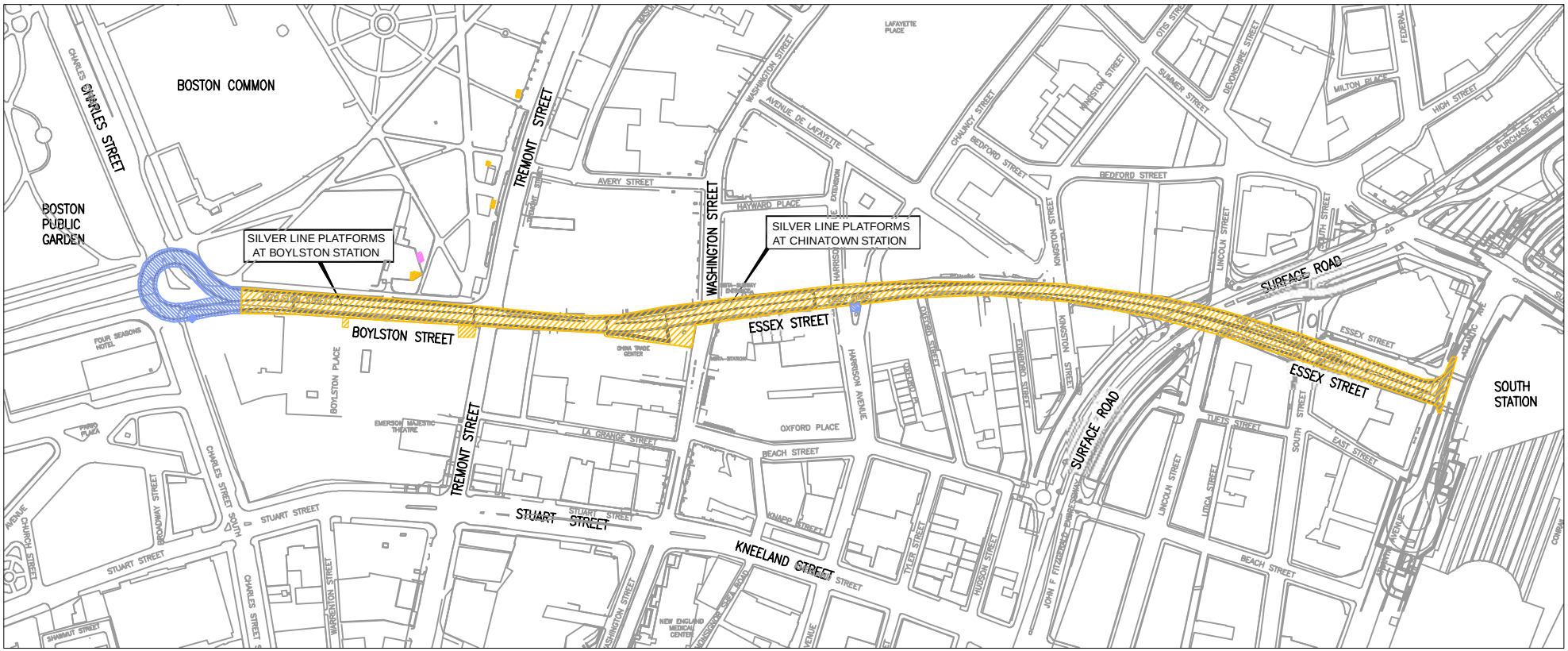
The cultural resources assessment determined that 10 percent of the Core Tunnel Segment is sensitive for significant archaeological resources (Figure 4.10-6). The proposed turnaround loop under Boylston Street at Charles Street is identified as containing significant pre-contact/contact period Native American fishweir site(s) in an archaeologically sensitive area). No significant archaeological resources are expected in the Essex Street right-of-way (ROW) and Boylston Street ROW project APE because of previous disturbances related to existing subway constructions, road constructions/maintenance and extensive underground utilities. For surface elements related to the proposed Boylston Silver Line Station, significant archaeological resources are identified at two of the proposed permanent structures in sensitive areas from 4 to 10+ feet below surface (Figure 4.10-6). Pre-contact/contact period Native American fishweir site(s) related to resource procurement in the tidal estuary and a late 18th century hemp house related to the historic ropewalks/cordage industry are identified at the proposed emergency tunnel vent at the southeast corner of Boylston and Charles Streets emergency tunnel vent. Post-contact period interments associated with the Central Burying Ground are identified at the proposed emergency egress adjacent to the Deer Park maintenance facility in Boston Common in an archaeologically sensitive area from 4 to 6 feet below surface. No significant archaeological resources are identified at the remaining surface elements related to the new Boylston Silver Line Station because of disturbances related to the construction of the existing tunnel system and stations.

For surface elements related to the proposed Chinatown Station improvements, significant archaeological resources are identified at one of the proposed permanent structures in a sensitive area from 5 to 10+ feet below surface. A pre-contact period Native American camp site and an eighteenth-nineteenth-century domestic site are identified at the proposed east ventilation shaft at the intersection of Harrison Avenue and Essex Street. No significant archaeological resources are identified at the remaining surface elements related to the Chinatown Station improvements because of disturbances related to the construction of the existing tunnel system and stations.

4.10.4.2 Tremont Street Alternative

The cultural resources assessment determined that 20 percent of the Tremont Street Alignment is sensitive for significant archaeological resources (Figure 4.10-7). No significant archaeological sites are identified within the Tremont Street right-of-way (ROW), which was severely disturbed by the construction of the original Tremont Street subway. The tunnel is still intact below the street in the area south of Boylston Street to at least the BRA Parcel south of the existing NEMC garage.

The New England Medical Center (NEMC) portal for this alternative is situated on the BRA parcel. Significant nineteenth-century domestic/commercial structures and former yard areas are identified in this section of the alternative in an archaeologically sensitive area from 2 to 10 feet below surface from 2-5 ft to 10 ft below ground.



ARCHAEOLOGICAL SENSITIVITY LEGEND

- Low
- Low to Moderate
- Moderate to High

N

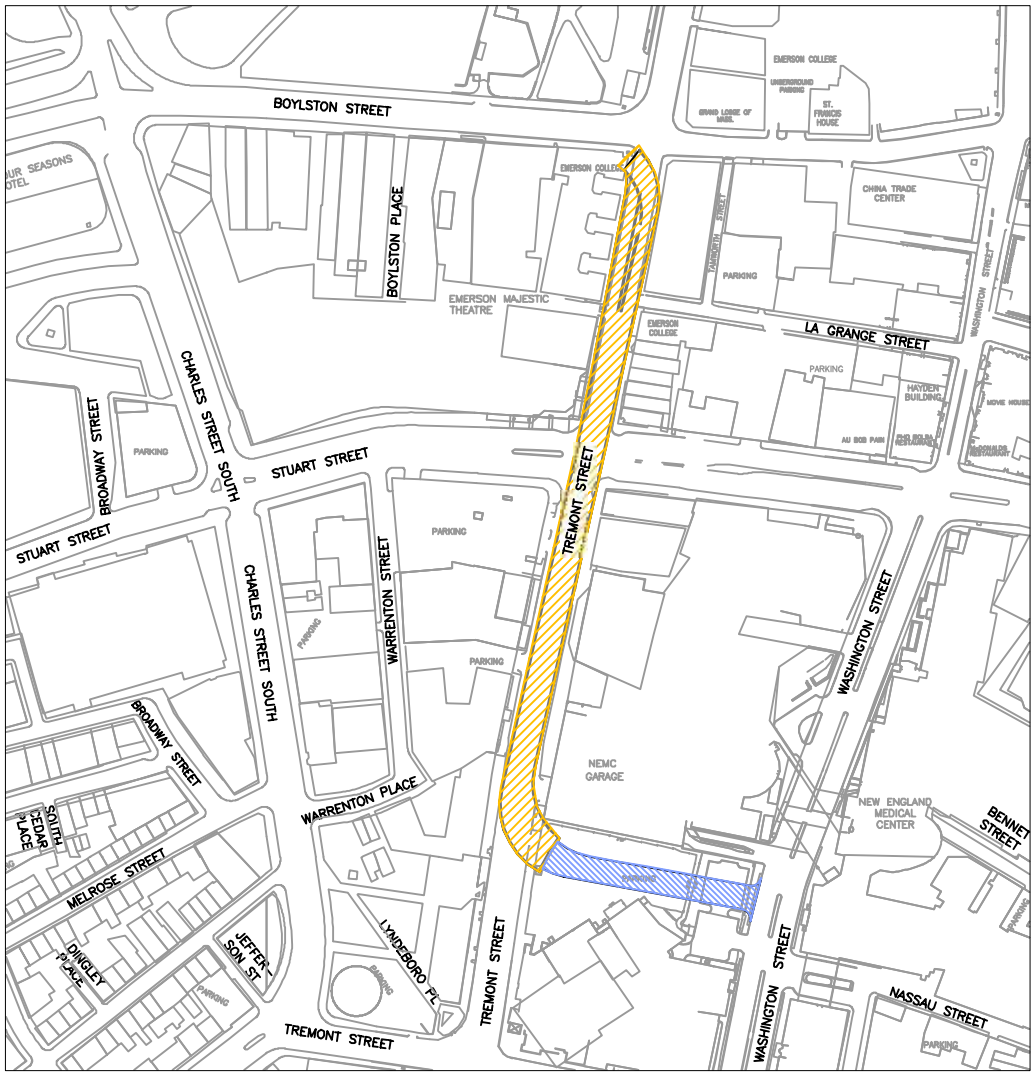
0 100 250 500ft

0 50 100 150m

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 4.10-6
Archaeological Resources - Core Tunnel Segment



ARCHAEOLOGICAL SENSITIVITY LEGEND

None to low

Moderate

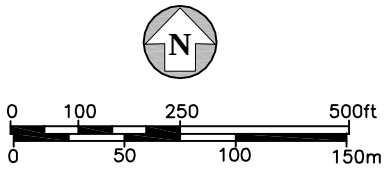


Figure 4.10-7
Archaeological Resources - Tremont Street Alignment

4.10.4.3 Charles Street Alternative

The cultural resources assessment determined that 95 percent of the Charles Street Alignment is sensitive for significant archaeological resources (Figure 4.10-8). The majority of this alternative is situated within the Charles Street ROW, which is identified as containing significant pre-contact period Native American fishweir site(s) The alignment is sensitive from below 5-10 ft of fill to the depth of natural yellow and blue clay and marine deposits. The southern end of the alternative along the north side of Elliot Norton Park is identified as containing pre-contact Native American fishweir and camp sites and eighteenth-nineteenth-century domestic/commercial structures and former yard areas in archaeologically sensitive areas from 2 to 10 feet below surface (see Figure 4.10-8). The Charles Street Alternative terminates at the NEMC portal, which is sensitive for the resources discussed above under the Tremont Street Alignment.

4.10.4.4 Stuart Street Alternative

The cultural resources assessment determined that 50 percent of the Stuart Street Alignment is sensitive for significant archaeological resources (see Figure 4.10-9). The Charles Street section of this alternative corresponds to that described above for the Charles Street Alternative, which contains significant pre-contact Native American fishweir site(s). No significant archaeological sites are identified for the Stuart Street section of this alternative Stuart Street, as currently laid out, dates from the early 1980s and the construction of the Massachusetts Transportation Building. These late modern period constructions obliterated the historic Elliot Street and any evidence of late 18th and 19th century streetscapes and buildings.

The Tremont Street section of this alternative corresponds to that described above for the Tremont Street Alternative, and does not contain any significant archaeological sites because of disturbance from the construction of the original Tremont Street subway. The Stuart Street Alternative terminates at the NEMC portal, which is identified as containing significant archaeological sites as described above for the Tremont Street Alternative.

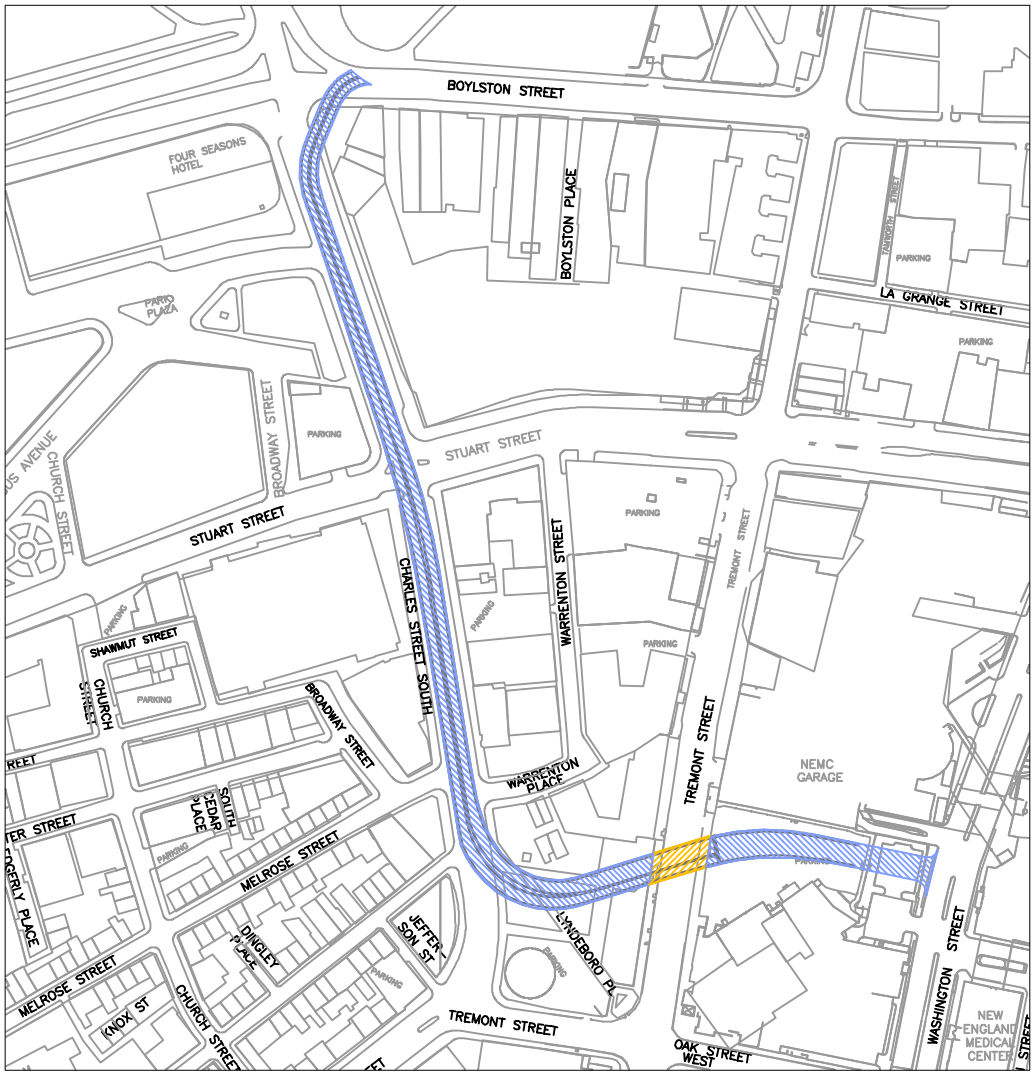
4.10.4.5 Columbus Avenue Alternative

The cultural resources assessment determined that all of the Columbus Avenue Alignment is sensitive for significant archaeological resources (see Figure 4.10-10). This Alternative and its portal between Arlington and Berkeley streets extend into the former salt marshes/tidal estuary of the Back Bay area, which were present west of the 1630 shoreline. The various soil borings taken within Columbus Avenue and adjacent sections of Stuart Street for other projects confirm the presence of intact organic silt and peat subsoils below the fill. These subsoil strata contain significant pre-contact period Native American resources related to the Back Bay fishweirs. The pre-1630 shoreline surfaces containing fishweir remains are as shallow as 4-5 ft at the Park Square end of the alignment to as deep as 42 ft below ground surface between Berkeley and Arlington Streets.

4.11 Parklands

4.11.1 Introduction and Regulatory Context

This section describes existing parkland resources within the study area. The study area for parklands includes resources that are adjacent to the proposed alignments or close enough to be affected by potential noise or vibration. Section 4(f) of the Department of Transportation Act of 1966, which protects public parks and recreation lands, is discussed in Section 5.11. All parks described in this section are protected under Section 4(f).



ARCHAEOLOGICAL SENSITIVITY LEGEND

None to low

Moderate

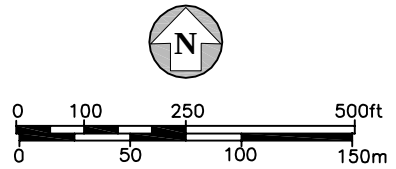
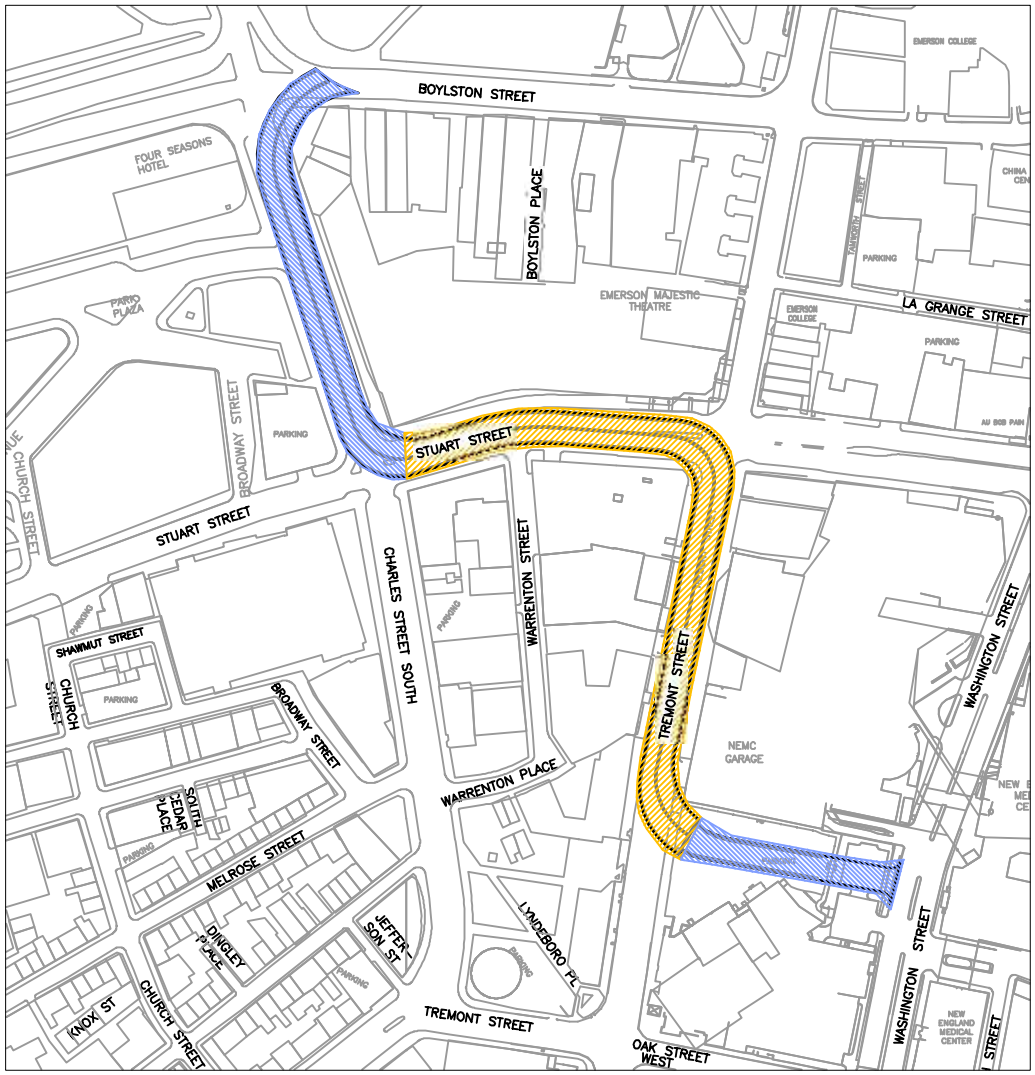


Figure 4.10-8
Archaeological Resources - Charles Street Alignment



ARCHAEOLOGICAL SENSITIVITY LEGEND

None to low

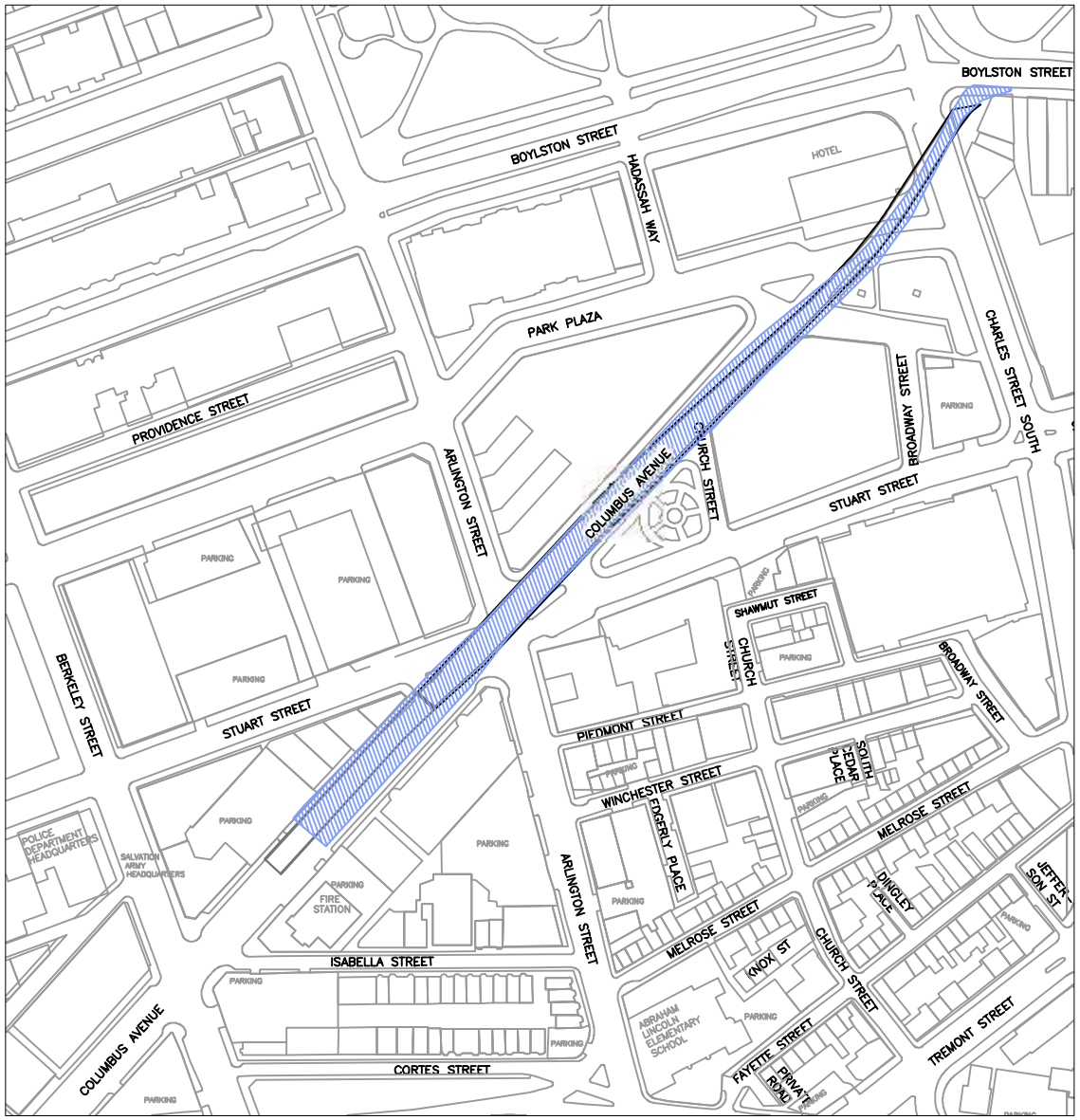
Moderate

N

0 100 250 500ft

0 50 100 150m

Figure 4.10-9
Archaeological Resources - Stuart Street Alignment



ARCHAEOLOGICAL SENSITIVITY LEGEND

Moderate

N

0 100 250 500ft

0 50 100 150m

Figure 4.10-10
Archaeological Resources - Columbus Avenue Alignment

Section 6(f) of the Land and Water Conservation Fund Act of 1965 established the Land and Water Conservation Fund, a matching assistance program that provides grants which pay half the acquisition and development cost of outdoor recreation sites and facilities. Section 6(f) of the act prohibits the conversion of property acquired or developed with these grants to a non-recreational purpose without the approval of the Department of Interior (DOI), National Park Service. The DOI must ensure that replacement lands of equal value, location and usefulness are provided as a condition of such conversions. Consequently, where conversions of Section 6(f) lands are proposed for highway projects, replacement lands are required. Improvements to the Boston Common and Public Garden were funded with Federal assistance from the Land and Water Conservation Fund and are potentially subject to Section 6(f).

Article 97 of the Constitution of the Commonwealth of Massachusetts protects public parks from being converted to other uses. The Article requires that parkland "shall not be used for other purposes or otherwise disposed of except by laws enacted by a two thirds vote, taken by yeas and nays, of each branch of the general court." Article 97 applies to all of the parklands described in this section.

4.11.2 Parklands within the Study Area

Parkland resources within the study area, owned by the Boston Parks and Recreation Commission, are listed and described below. Figures 4.11-1 and 4.11-2 include a photograph of these parkland resources.

The Boston Common, one of the most well-known recreational resources in downtown Boston, is a local and national landmark and listed on the National Register of Historic Places. Since it was established in 1634, the Common has been an important place for public assembly in Boston and has been the site for many historic occurrences. The Boston Common's 50 acres provide the most significant parkland area within downtown Boston, while also functioning as a neighborhood park for Chinatown, Bay Village, Beacon Hill and Back Bay[11].

The historic Boylston Green Line Station headhouses are located on the southeast corner of the Common. The Deer Park Maintenance Yard operated by the Boston Parks and Recreation Department is located along Boylston Street to the west of the Boylston Station inbound headhouse. The Deer Park Maintenance Yard is enclosed with a stone wall and contains a parking area and vent structures for the Green Line. The Central Burying Ground is an important historic resource located along Boylston Street to the west of the Deer Park Maintenance Yard.

Boston Public Garden contains approximately 24 acres, and combines with the Common to provide green space that links different parts of Boston. Located to the west of Charles Street, the Public Garden was the first public botanical garden in the United States, established in 1837 and laid out in its present form in the 1860's[12] The Public Garden provides a different type of open space than the Boston Common. It is focused on passive recreation and is more ornamental with fewer structures, no vendors, and stricter regulations about the types of activities allowed.

The Bay Village Neighborhood Park is a 0.08-acre "pocket park". This small park provides a passive recreation area on the west side of Charles Street South, between Melrose Street and Fayette Street.

[11] The Boston Common Management Plan. City of Boston Parks and Recreation Commission. 1996.

[12] Ibid.

Bay Village Neighborhood Park

Elliot Norton Park

Figure 4.11-1
Parkland Resources
Charles Street Alignment

Lincoln Square

Statler Park

Figure 4.11-2
Parkland Resources
Columbus Avenue Alignment

Elliot Norton Park is a one-acre neighborhood park located between Tremont Street and Charles Street South, within the Bay Village Neighborhood. Elliot Norton Park has a fenced-in area for children's play equipment, green space, and paved pathways that lead from Charles Street South to Tremont Street. Amenities include benches, planters, concrete bollards, decorative lampposts and trees. A fence separates the park from Tremont Street, and the Charles Street side of the park is just above the sidewalk grade. The park was dedicated in 1977 to Elliot Norton, a noted theater critic for the *Record American*; it was renovated in the early 1990s.

Lincoln Square is a .06-acre park, bounded by Columbus Avenue, Charles Street South and Stuart Street. Lincoln Square contains the Emancipation Group Monument, a bronze statue.

Statler Park is a triangular 0.25-acre park, bounded by Columbus Avenue, Stuart Street and Church Street. The park includes some landscaped areas, a decorative fountain, benches and a cement pathway allowing access between Stuart Street and Columbus Avenue.

4.12 Visual and Aesthetics

The Silver Line Phase III project would be primarily underground and the only potential for visual impacts would occur when it interacts with the surface, at the proposed portal locations. This section, therefore, describes the existing visual environment in these areas, focusing on the elements, such as city sidewalks, that would be affected by the project.

4.12.1 NEMC Portal

The visual environment in the area of the NEMC portal is high density urban development characterized by eight to twelve story institutional and commercial buildings, structured parking, surface parking, multi-lane city streets with parking and sidewalks, ornamental street lighting and street trees (see Figure 4.12-1). There are two levels of surface parking separated by a low retaining wall and stair for pedestrians north of the Doubletree Hotel. The site slopes gently from west to east with Tremont Street higher than Washington Street. A pedestrian path through surface parking and adjacent to the NEMC parking garage crosses over the proposed portal alternative. The pedestrian path is not handicapped accessible; it is paved with bituminous concrete and is separated from parking areas by a low chain link fence.

The city sidewalk on Washington Street south of the proposed portal is buffered from the surface parking by a concrete wall with an ornamental red fence backed by shade trees. The sidewalk is approximately 12 feet wide and is made of cement concrete with a 3-foot wide brick accent band. The sidewalk experiences a high amount of pedestrian traffic among all age groups.

The NEMC portal area passes through two properties owned by the BRA, Parcel 2 and Parcel P-12B. These parcels are designated in the South Cove Urban Renewal Plan for institutional use, including housing, with a maximum FAR of 8. The BRA intends to offer these parcels for mixed-use development, with potential housing on the west side of the site facing Elliot Norton Park. Among other potential uses of the land identified by the BRA is the extension of the existing abutting NEMC parking garage. The remainder of the portal site would occupy a portion of the Doubletree Hotel site used for parking.

4.12.2 Columbus Avenue Portal

The visual environment in the area of the Columbus Avenue portal is medium density urban development characterized by three to five story commercial buildings, surface parking, multi-lane city streets with parking and sidewalks, and ornamental street lighting (see Figure 4.12-2). On the south side of the street there is a fire station, surrounded by surface parking.

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Figure 4.12-1
NEMC Portal Area

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Figure 4.12-2
Columbus Avenue Portal Area

The traffic lanes affected by the Columbus Avenue portal alternative are the two westbound lanes and parking lane of a typical high volume, low speed, urban street paved with bituminous concrete. Two eastbound lanes are not affected, although access to parking on the south side of Columbus Avenue between Berkeley and Arlington may need to be limited due to street geometry.

The sidewalk on the north side of Columbus Avenue near the intersection with Berkeley Street averages eight feet in width and is cement concrete with a granite curb. There are several curb cuts along the sidewalk for building access. The sidewalk carries medium to heavy pedestrian loads depending on the time of day.

CHAPTER 5.0 Environmental Consequences

5.1 Introduction

This chapter presents the long-term impacts associated with the Silver Line Phase III Build Alternatives for each of the environmental categories required by the Federal Transit Administration (FTA) and those categories listed in the Massachusetts Environmental Policy Act (MEPA) scope prepared in response to the June 2004 Notice of Project Change (NPC). Construction phase impacts are discussed separately in Chapter 6.0. Chapter 7.0 summarizes and compares the impacts for the Silver Line Phase III Alternatives. For each environmental category the No-Build Alternative serves as the basis for determining the impact associated with the Build Alternatives, in each case, as appropriate, beginning with a discussion of the Core Tunnel Segment, which is common to all four of the Build Alternatives (see Chapter 3 for a description of alternatives). Environmental categories with operational impacts, such as traffic and air quality, compare the No-Build to the Build Alternatives for 2013, the year that Phase III of the Silver Line is planned to be operational. In addition, the traffic analysis includes analysis for the horizon year of 2018.

While the No-Build serves as the point of comparison for evaluating the environmental impacts of the Build Alternatives as required by the National Environmental Policy Act (NEPA), the Baseline Alternative serves as the FTA-approved point of comparison for quantifying transportation system user benefits and other related New Starts measures. (See Chapter 3.0 for additional discussion.) Under the Baseline Alternative, Phases I and II would remain as separate services, but Phase I peak headways would decrease from 4.0 to 3.3 minutes, and Phase II peak headways would decrease from 1.3 minutes to 0.8 minutes in the tunnel between South Station and the World Trade Center. In addition, a bus route from the Back Bay to Boylston Station would run on a 10-minute-headway, mimicing the Back Bay route associated with the Build Alternatives. There is no construction associated with the Baseline Alternative, and therefore there would be no associated land acquisition and displacement, geology and groundwater, historic and archaeological resources, parklands, natural resources, or visual impacts. This alternative would increase the frequency of the Phase I and II services to a level consistent with that proposed for the Build Alternative. To achieve this increased frequency, three vehicles per hour would be added in each direction to Washington Street for Phase I service. The addition of these vehicles to an existing urban street is not anticipated to result in any measurable increase in traffic, air quality, noise, or vibration impacts compared to future No-Build conditions. The increase in Phase II frequency would occur entirely within the existing Phase II tunnel and therefore would not result in traffic, air quality, noise, and vibration impacts to the community.

The remainder of this chapter focuses on the environmental impacts of the Build Alternatives.

5.2 Socioeconomics and Land Use

5.2.1 Land Acquisition and Displacement, Community Cohesion

The proposed Silver Line Phase III Core Tunnel Segment and portal alignment alternatives have been designed to follow existing public roadways to the maximum extent feasible. It is anticipated that agreements between the MBTA and the City of Boston would not require property acquisitions or easements for the tunnel alignment and stations within the public right-of-way (ROW), thereby minimizing the need for land acquisitions. Additionally, because most of the alignment is underground, any required land acquisition would be below-ground easements required where the stations or tunnels run underneath private or public property. Surface level takings and impacts to buildings outside the public ROW would occur at the proposed station

sites (Boylston and Chinatown) and at the proposed portals (New England Medical Center (NEMC) or Columbus Avenue). Permanent land acquisitions and easements required for Phase III are summarized below.

There would be no impact to community cohesion from the implementation of the any of the Build Alternatives, since none of them would physically separate neighborhoods. Once constructed, the Silver Line Phase III would be primarily in a tunnel and the surface streets and sidewalks would be similar to what they are today. Either of the portal locations would provide be designed to accommodate vehicular and pedestrian movements. (See sections 5.3 and 5.4 for additional discussion of traffic and pedestrian issues.)

5.2.1.1 Core Tunnel Segment

Permanent land acquisitions outside the public ROW would be required to accommodate above-ground elements of the project such as headhouses, ventilation structures, and emergency egress. A permanent land acquisition may also be required to locate a new power substation for the Silver Line III tunnel traction power system if a suitable location in an existing MBTA facility is not available.

Permanent easements would be required to reserve space for the below-grade portions of the alignment, including tunnels, stations and passageways wherever the alignment is located outside of the public ROW. Permanent easements may be required to locate egress or ventilation elements within existing buildings at certain locations.

Acquisitions of all real property and easements would be completed in accordance with applicable provisions of the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended* and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all business relocations without discrimination. There are no residential land acquisitions associated with the Phase III Silver Line project.

Table 5.2-1 presents a summary of the permanent land acquisitions anticipated for the Silver Line Phase III project Core Tunnel Segment. The information in the following table represents the estimated proposed takings and underground easements based on a preliminary level of design and the location and area required may change as the level of design progresses. As indicated in Table 5.2-1, private property impacts for the Core Tunnel Segment would be minimal. Most of the surface level impacts occur within the public ROW or on land owned by public agencies.

Table 5.2-1 – Proposed Surface-Level Acquisitions/Easements for the Core Tunnel Segment

Project Component	Address, Location/ Property Ownership	Area (square feet)	Existing Use	Easement or Taking Required?
Boylston Station				
Station access	74-94 Boylston Street, the Little Building / Emerson College	Easement within building - approximately 1,000-1,100 sf	Commercial	Yes – Private Property
Emergency egress structures	Boston Common next to the Deer Park Maintenance Facility / Boston Parks & Recreation Department	200-250 sf	Recreation	Yes - Public Agency
	124 Boylston Street / Emerson College	300 sf	Commercial	Yes – Private Property
Tunnel Vent Shafts	Corner of Charles Street and Boylston Street/ City of Boston	200 sf	Sidewalk	No – within ROW
	Within the existing Green Line vent shaft	200-300 sf	Transit	No – within existing MBTA vent shaft
Station Ventilation Grates (2)	These ventilation grates would be within the ROW of Boylston Street/City of Boston	100 sf each	ROW	No – within ROW
Green Line Emergency Egress (2)	Boston Common / Boston Parks & Recreation Department	250-300 sf	Recreation	Yes – Public Agency
Green Line Elevator	Boston Common / Boston Parks & Recreation Department	80-100 sf	Recreation	Yes – Public Agency
Chinatown Station				
Tunnel Vent Shafts and Station Ventilation Grates	The two tunnel vent shafts and two station ventilation grates would be within the street ROW/City of Boston	500-600 sf	ROW/Sidewalk	No – within ROW
Emergency Egress/Headhouse	Location to be determined - either in front of or within the basement of the China Trade Building at 2 Boylston Street/Boston Redevelopment Authority (BRA)	300 sf	Sidewalk or Commercial	Either within ROW or from Public Agency

In addition to surface-level easements noted above, an underground easement in the Boston Common (approximately 5,200 square feet) is needed for the turnaround loop at the intersection of Charles Street and Boylston Street.

5.2.1.2 NEMC Portal (Tremont, Charles, and Stuart Street Alternatives)

The NEMC portal would take approximately 17,440 square feet of two parcels owned by the BRA, which would eliminate approximately 80 parking spots within the Auto Parks Parking lot (see Section 5.3, Traffic and Parking for a detailed discussion of parking impacts and mitigation). The Auto Parks Parking lot is leased from the Boston Redevelopment Authority (BRA). The two properties owned by the BRA, Parcel 2 and Parcel P-12B are designated in the South Cove

Urban Renewal Plan for development for institutional use, including housing, with a maximum floor-to-area ratio (FAR) of 8. The BRA intends to offer these parcels for mixed-use development, with potential housing on the west side of the site facing Tremont Street. Among other potential uses of the land identified by the BRA is the extension of the existing abutting New England Medical Center parking garage. Although there would be surface-level land use impacts, the NEMC portal would not preclude future air-rights development above the portal. (See Section 5.12).

The portal would also take approximately 5,450 square feet of property owned by CJ Washington Street LLC (the Doubletree Hotel), which would eliminate approximately 14 off-street parking spots. (Section 5.3, Traffic and Parking, describes these impacts and mitigation in more detail.) The BRA disposition documents transferring the Doubletree Hotel property to CJ Washington Street LLC provided notice that the MBTA proposed to use a portion of the property (identified as Parcel 1) "for the location of a transportation corridor known as the Silver Line (the Silver Line Crossing)", and that "if the Silver Line Crossing is to be constructed, the MBTA will be required to take the required portion of Parcel 1 by eminent domain." [1]

Tremont Street Alternative

In addition to the takings at the NEMC portal, the Tremont Street Alternative requires additional underground easements along Boylston Street which are described in Table 5.2-2.

Table 5.2-2 – Proposed Below-Grade Permanent Easements for Tremont Street Alternative

Address	Owner	Square Feet of Required Easement
Boston Common	City of Boston, Parks Department	3,400
51 Boylston St	Masonic Education & Charity	1,100
62 Boylston St	Boylston Downtown LP	1,620

Charles Street Alternative

In addition to the takings at the NEMC portal, the Charles Street alignment alternative would require approximately 12,000 square feet of permanent below-grade easement underneath Elliot Norton Park. There would be no permanent impact at the surface, as the park would be restored after construction. (See Chapter 6.0 for additional discussion of construction phase impacts.)

Stuart Street Alternative

This alternative would not require any additional easements or takings, beyond that required for the NEMC portal.

5.2.1.3 Columbus Avenue Portal

The Columbus Avenue Alternative would require a 120 square feet underground easement underneath a parcel of land adjacent to the Four Seasons Hotel owned by the Boston Plaza Hotel

[1] Approval, Waiver and First Amendment to Land Disposition Agreements, recorded March 29, 1999, Suffolk Registry of Deeds.

Associates. The tunnel alignment and portal are located within the right-of-way of Columbus Avenue.

In addition, the proposed geometric improvements at the intersection of Herald and Washington Streets (see Figure 3.5-4), would require the acquisition of approximately 305 square feet of land owned by Chinese Consolidated. The Columbus Avenue portal would also affect access from Columbus Avenue to the buildings located along the north side of the Columbus Avenue block between Berkeley and Arlington Streets. Pedestrian access to these buildings would not be impeded, but the portal location and ramp to the surface would affect loading, services and other functions. These buildings also front on Stuart Street; there will be no change in building access from Stuart Street. Access impacts are described in detail in Section 5.3, Traffic and Parking and would include the following:

- 155 Columbus Avenue (Salvation Army) – vehicular access from Columbus Avenue to the parking lot and service entrance would be impeded;
- 147 Columbus Avenue (Benjamin Franklin Smith Printers) – vehicular access to the loading dock on Columbus Avenue would be impeded; pedestrian access from Stuart Street would remain;
- 139 Columbus Avenue, (Baron Baptiste Yoga) - vehicular access to the entrance on Columbus Avenue would be impeded; pedestrian access would be unaffected. This building also has access from Stuart Street, which would be unaffected.
- 135 Columbus Avenue (Flash's Cocktails) – vehicular access to the service entrance on Columbus Avenue would be impeded. The primary access to this business is from Stuart Street, which would be unaffected.

Mitigation for these access impacts is discussed in Section 5.3.

5.2.2 Consistency with Local Plans

Phase III of the Silver Line is a committed project in the region's long-range transportation plan and would be entirely consistent with local land use and development plans. The policies of the Boston Redevelopment Authority (BRA), as expressed in specific plans and its ongoing development review process for the downtown and Waterfront area, encourage the strongest possible relation of development to transit, both at the overall density allocation scale, and at the detailed scale of planning for individual pedestrian ways and pedestrian open spaces. As an underground tunnel connecting Phases I and II, all Build Alternatives would be supportive of these plans and policies by providing increased accessibility between key activity centers in the downtown core. Consistency with Boston's Open Space Plan would be somewhat reduced in the case of the Charles Street Alternative, which requires temporary disruption of Elliot Norton Park; however, that park would be fully reconstructed and restored at the completion of Phase III construction activities. The project also will be consistent with other regional and state land use plans and policies, including the Metropolitan Area Planning Council's MetroPlan 2000, which calls for concentrated development that encourages and enhances transit use, and Executive Order 385, Planning for Growth, which promotes sustainable development.

5.3 Traffic and Parking

This section describes potential impacts to traffic and parking resulting from implementation of the Build Alternatives. Since most of Silver Line Phase III would operate in a dedicated tunnel, permanent traffic and parking impacts would only occur near the proposed NEMC and Columbus Avenue portals, where the Silver Line vehicles would access the surface. Therefore this section

focuses on an analysis of the NEMC portal for the Tremont, Charles, and Stuart Street alignment alternatives, and on the Columbus Avenue portal for the Columbus Avenue alternative. The proposed No-Build and Build conditions are projected for the year when revenue service on Silver Line Phase III is projected to begin – 2013.

In order to properly project future traffic conditions and to ensure that impacts are properly assessed, a growth factor of one percent per year was added to the 2004 Existing Conditions traffic volumes to provide for the normal background growth of traffic as reviewed the direction of Boston Transportation Department (see Section 4.4)[2]. In addition, any traffic associated with any other known project that will be completed prior to 2013, such as the Columbus Center Project and the Clarendon Project, have been added to the Existing Conditions traffic in order to develop a conservative projection of the 2013 No-Build Alternative turning movement volumes. As a result, the traffic analysis assumes that projects such as Columbus Center and The Clarendon are in the build scenario.[3] Finally, the volumes were reviewed to develop a balance of traffic flow between intersections and adjusted as required. Traffic data also comprise the 2013 forecasts developed for the completion of the Central Artery Project as provided by Cambridge Systematics.

The 2018 Horizon Year analysis examines the traffic conditions in the study area five years after completion of the Silver Line Phase III project, consistent with MEPA guidelines. Traffic volumes for 2018 were developed by applying a factor of one percent per year, for normal background growth of traffic, to the 2013 Build Alternative turning movement volumes. Additional information and backup traffic data is presented in Appendix D.

5.3.1 New England Medical Center (NEMC) Portal

The NEMC portal is associated with the Tremont Street, Charles Street, and Stuart Street alignment alternatives. Proposed traffic improvements and Silver Line vehicle operations are also incorporated into the 2013 Build volumes and level-of-service (LOS) analysis. Because stakeholders near the proposed portals have expressed concern about access impacts for emergency vehicles entering the NEMC facility, a separate analysis was conducted to determine whether the Silver Line Phase III project would affect emergency access (see Section 5.3.1.3). These results are summarized with the 2013 Build conditions analysis.

5.3.1.1 Street Layout and Portal Location

Construction of Silver Line Phase III would create a new intersection between the NEMC Garage and the Doubletree Hotel, for the Tremont Street, Charles Street, and Stuart Street Alternatives, providing access from Washington Street to the tunnel portal.

A dedicated 11-foot left-turn lane would be provided along Washington Street for the Silver Line vehicle to facilitate inbound access to the portal. (See Figures 5.3-1a and 5.3-1b; Figure 3.4-7 provides additional detail on the portal.) This left-turn lane was specifically integrated in the Washington Street design in order to avoid the blockage of the emergency entrance to NEMC at Nassau Street. An inbound Silver Line vehicle on Washington Street would utilize this bus-only left-turn lane to wait for an opening in southbound Washington Street traffic before turning left to enter the portal.

[2] Expansion of transit services, such as Silver Line Phase III are intended to reduce dependency on automobiles.

3 Columbus Center Final Impact Report – Howard/Stein Hudson Inc. submitted to Boston Redevelopment Authority, May 15, 2003. The Clarendon Draft Project Impact Report - Howard/Stein Hudson Inc. submitted to Boston Redevelopment Authority, June 30, 2004.

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AUTHORITY

SILVERLINE

Figure 5.3-1a
NEMC Portal
Bus Turn Lane

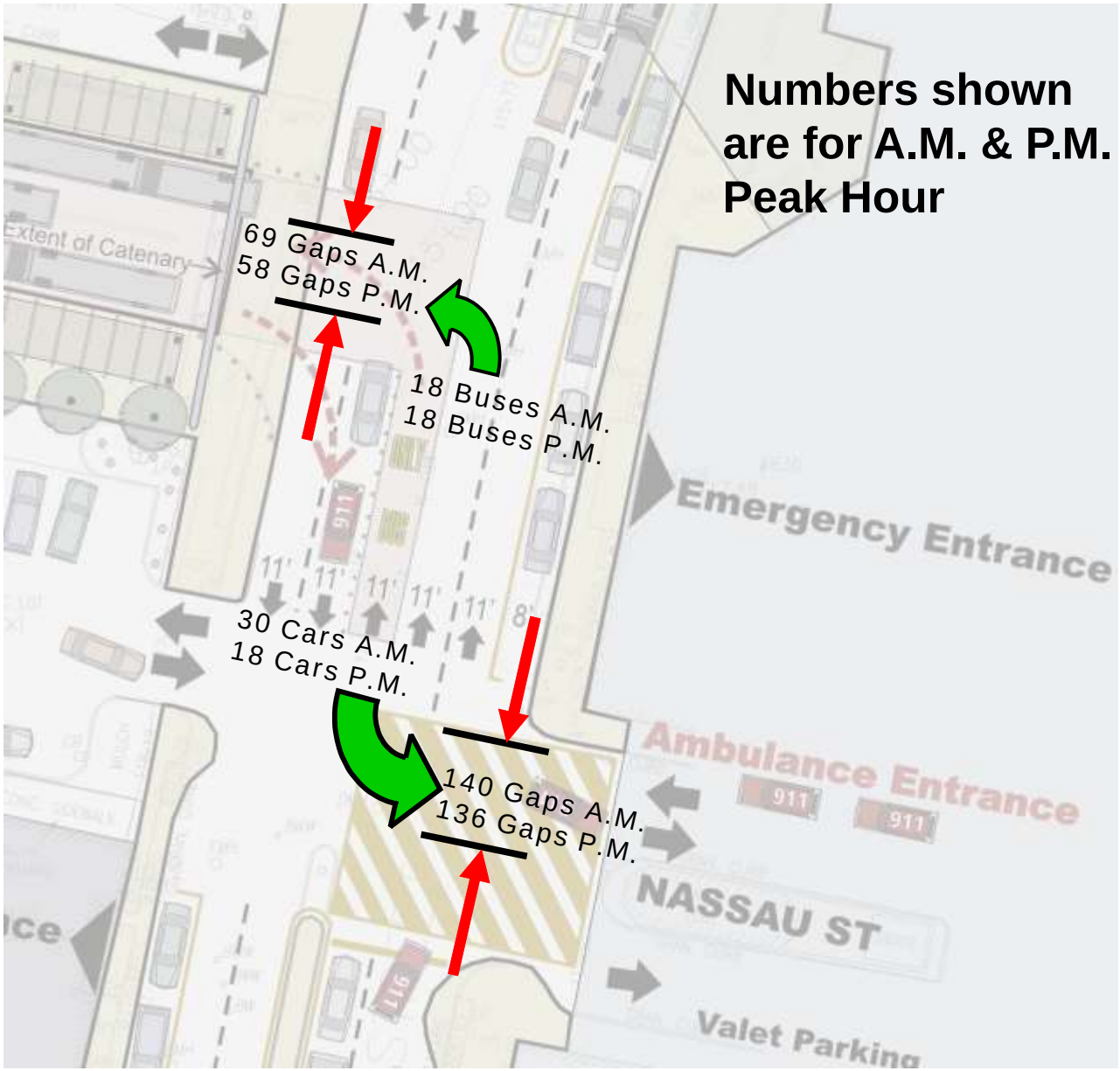


Figure 5.3-1b
NEMC Gap Analysis

5.3.1.2 2013 Traffic Volumes and Intersection Level of Service (LOS) Analysis Results

The section describes traffic impacts for the intersections within the Washington Street corridor that would be affected by operation of the Silver Line Phase III Build Alternatives utilizing the NEMC portal, including a new intersection created at the Washington Street/Silver Line Portal. Because the number of vehicles that could be added to other local roadway traffic represents such a small percentage of total traffic, no other impacts are anticipated beyond the intersections analyzed. The 2013 No-Build and Build Alternative LOS analyses results for the unsignalized and signalized intersections are summarized and compared in Tables 5.3-1 and 5.3-2, and illustrated in Figures 5.3-2 and 5.3-3, respectively.

Table 5.3-1 – Comparison of 2013 No-Build and Build Alternatives LOS Analysis Results for the New England Medical Center Portal, Unsignalized Intersections

Location	2013 No-Build			2013 Build		
	V/C	Delay	LOS	V/C	Delay	LOS
Morning Peak Hour						
Washington St. and Nassau St./ Doubletree Hotel Entrance/Exit						
Washington St. Northbound, Left Turn	0.01	8.4	A	0.01	8.7	A
Washington St. Southbound, Left Turn	0.05	9.5	A	0.05	9.7	A
Nassau Street	0.02	16.7	C	0.02	17.7	C
Doubletree Hotel Entrance/Exit	0.03	15.3	C	0.03	17.4	C
Washington St. and Silver Line Portal	N/A	N/A	N/A			
Washington St. Northbound, Left Turn				0.04	12.9	B
Silver Line Portal				0.06	16.6	C
Evening Peak Hour						
Washington St. and Nassau St./ Doubletree Hotel Entrance/Exit						
Washington St. Northbound, Left Turn	0.01	8.6	A	0.01	9.0	A
Washington St. Southbound, Left Turn	0.05	9.1	A	0.05	9.2	A
Nassau Street	0.01	15.0	B	0.01	15.8	C
Doubletree Hotel Entrance/Exit	0.02	17.8	C	0.02	20.4	C
Washington St. and Silver Line Portal	N/A	N/A	N/A			
Washington St. Northbound, Left Turn				0.05	13.6	B
Silver Line Portal				0.07	17.6	C

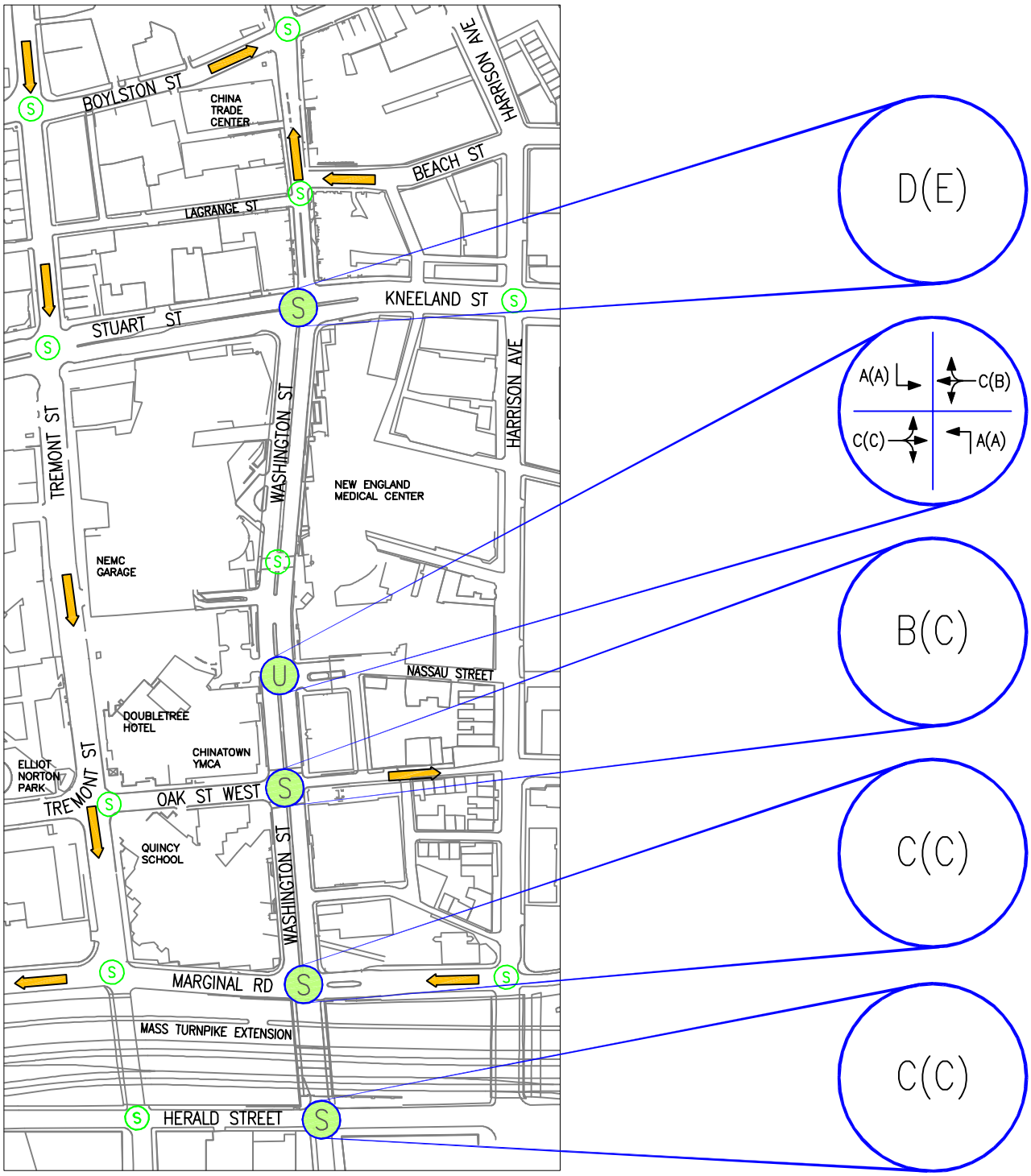
Source: URS / DMJM+HARRIS, Joint Venture, 2005
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle for a particular movement (s) in seconds.
LOS = Level of Service.

As would be expected, the 2013 No-Build conditions represent a slight increase in delays from 2004 (existing conditions) at study area intersections due to background traffic growth and traffic associated with other future projects, unrelated to the Silver Line. (See Section 4.2.4 for discussion of existing traffic conditions.) The overall intersection LOS remains unchanged except for the Washington Street/Kneeland Street and Washington Street/Herald Street locations; with a decrease from LOS C to LOS D for the morning peak hour period. It should be noted that the Washington Street/Kneeland Street intersection remains at an unacceptable condition (LOS E) during the evening peak period.

Table 5.3-2 – Comparison of 2013 No-Build and Build Alternatives Signalized Intersection LOS Analysis Results for the New England Medical Center Portal

Location	2013 No-Build			2013 Build		
	V/C	Delay	LOS	V/C	Delay	LOS
Morning Peak Hour						
Washington St. and Kneeland St./Stuart St.		40.3	D		32.6	C
Eastbound, Left	**0.93**	**82.5**	**F**	**0.85**	**63.9**	**E**
Eastbound, Thru	**0.99**	**55.5**	**E**	0.91	38.1	D
Westbound, Left	0.69	27.4	C	0.64	23.0	C
Westbound, Thru	0.71	19.5	B	0.69	19.3	B
Northbound, Thru	0.88	43.8	D	0.82	40.7	D
Washington St. and Oak St.		11.3	B		11.8	B
Eastbound, Thru	0.77	32.3	C	0.78	32.9	C
Northbound, Thru	0.65	6.9	A	0.68	7.1	A
Southbound, Thru	0.14	4.4	A	0.16	5.9	A
Washington St. and Marginal St.		22.1	C		23.4	C
Westbound, Thru	0.27	23.8	C	0.27	23.7	C
Northbound, Left	0.58	18.3	B	0.60	18.1	B
Northbound, Thru	0.58	17.9	B	0.60	17.7	B
Southbound, Thru	0.29	35.5	D	0.38	37.4	D
Southbound, Right	**0.83**	**62.2**	**E**	**0.91**	**79.1**	**E**
Washington St. and Herald St.		37.0	D		36.8	D
Eastbound, Left	0.37	37.7	D	0.42	32.5	C
Eastbound, Thru	0.59	16.8	B	0.58	16.5	B
Westbound, Right	**1.12**	**94.3**	**F**	**1.12**	**94.3**	**F**
Northbound, Thru	0.40	15.6	B	0.43	16.2	B
Northbound, Right	0.04	14.8	B	0.04	15.2	B
Southbound, Thru	0.05	0.0	A	0.07	0	A
Evening Peak Hour						
Washington St. and Kneeland St./Stuart St.		**74.5**	**E**		**61.8**	**E**
Eastbound, Left	0.63	33.1	C	0.60	30.4	C
Eastbound, Thru	**1.24**	**131.7**	**F**	**1.16**	**105.8**	**F**
Westbound, Left	0.76	30.9	C	0.68	27.4	C
Westbound, Thru	0.46	17.6	B	0.45	17.5	B
Northbound, Thru	0.61	29.2	C	0.59	29.0	C
Washington St. and Oak St.		24.6	C		25.3	C
Eastbound, Thru	0.94	52.4	D	**0.95**	**55.2**	**E**
Northbound, Thru	0.49	10.6	B	0.51	10.4	B
Southbound, Thru	0.23	15.3	B	0.24	15.5	B
Washington St. and Marginal St.		23.2	C		24.2	C
Westbound, Thru	0.35	34.1	C	0.34	34.0	C
Northbound, Left	0.36	16.0	B	0.39	16.1	B
Northbound, Thru	0.37	15.5	B	0.39	15.5	B
Southbound, Thru	0.38	53.7	D	**0.48**	**59.8**	**E**
Southbound, Right	**0.80**	**71.3**	**E**	**0.86**	**77.1**	**E**
Washington St. and Herald St.		24.2	C		24.1	C
Eastbound, Left	0.46	43.3	D	0.50	43.5	D
Eastbound, Thru	0.82	24.3	C	0.82	24.2	C
Westbound, Right	0.82	30.9	C	0.82	30.9	C
Northbound, Thru	0.29	17.3	B	0.32	17.6	B
Northbound, Right	0.09	17.5	B	0.09	17.5	B
Southbound, Thru	0.05	0.0	A	0.06	0.0	A

Source: URS / DMJM+HARRIS, Joint Venture, 2005.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.



LEGEND

LEVEL OF SERVICE
C(C): LOS AM PEAK (LOS PM PEAK)

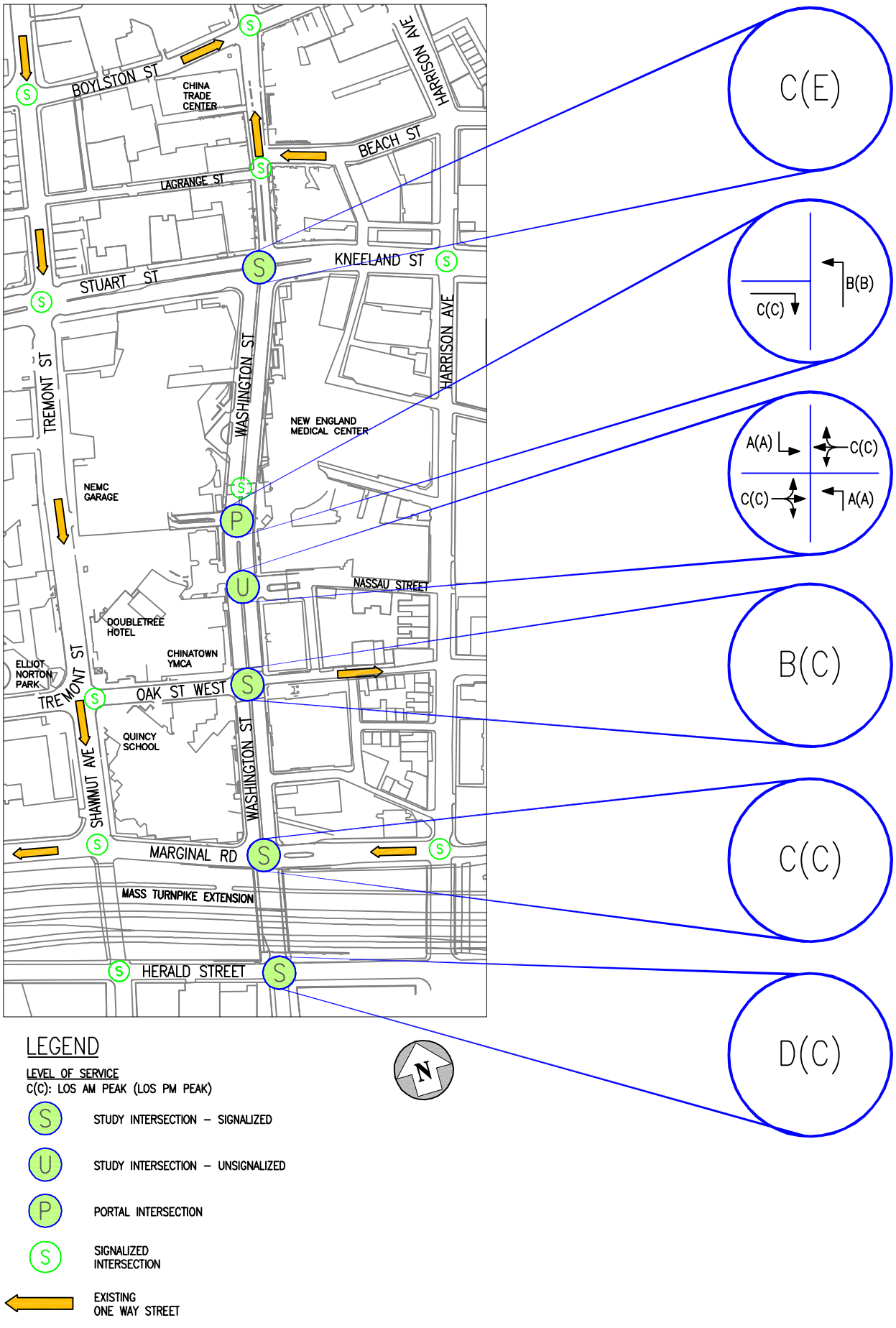
- STUDY INTERSECTION – SIGNALIZED
- STUDY INTERSECTION – UNSIGNALIZED
- SIGNALIZED INTERSECTION
- EXISTING ONE WAY STREET

N

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 5.3-2
2013 NEMC Portal
No-Build LOS



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 5.3-3
2013 NEMC Portal Build LOS

Tables 5.3-1 and 5.3-2 show that there is little difference in the LOS between the 2013 No-Build and 2013 Build. These results indicate that the Silver Line Phase III project would have a negligible impact to travel times, capacity and congestion within the Washington Street corridor in the NEMC portal area. It should be noted that the most congested intersection within the corridor, Washington Street/Kneeland Street, would experience a slight improvement with the implementation of Silver Line Phase III. This improvement occurs because some Silver Line vehicles that currently operate on the surface along Washington Street to Temple Place would instead enter the Phase III tunnel at NEMC, reducing bus volumes at the Kneeland Street intersection.

The new, project-created, unsignalized intersection of Washington Street and Silver Line NEMC portal would operate at LOS B/C in 2013. This intersection is designed with an exclusive left-turn lane along the Washington Street northbound approach for inbound Silver Line vehicles only.

Traffic Safety

Accident history in the vicinity of the portal area does not indicate any safety concerns. The proposed action also reduces the number of buses using the intersection with the highest accident experience; the Washington/Kneeland Street/Stuart Street intersection. Locating the Silver Line Phase III portal at NEMC, therefore, is not expected to have a negative impact on traffic safety.

5.3.1.3 Emergency Vehicles/Gap Analysis

Emergency vehicle access to NEMC facilities has been identified as a potential impact of the Silver Line Phase III NEMC portal. Therefore, a separate analysis (a "gap analysis") was conducted to determine the potential for Silver Line Phase III vehicles using the NEMC portal to interfere with emergency vehicles and other traffic. The portal and proposed street layout was designed to prevent potential vehicle conflict.

The dedicated left-turn lane (inbound) for the Silver Line vehicle (see Figure 5.3-1b) was specifically integrated in the Washington Street design in order to avoid the blockage of the emergency entrance to NEMC on Nassau Street. A Silver Line vehicle on Washington Street going inbound and waiting for clearance to enter the portal would be using this bus-only left-turn lane, and should not at any point be blocking the way for potential ambulances coming from the north on Washington Street and turning left to access the emergency entrance.

In addition to the LOS analysis, a gap analysis was conducted between the hours of 6:00 AM to 6:00 PM, in the vicinity of the proposed portal location. The analysis was conducted in order to obtain a more accurate understanding of the traffic movement around the future portal location, the Doubletree Hotel and, specifically, access to Nassau Street (NEMC emergency entrance). Gaps in traffic (measured from the arrival of the rear of a vehicle to the front of the following vehicle) were observed along Washington Street northbound and southbound. Following are the results of this analysis, which are presented first for northbound traffic and then for southbound traffic on Washington Street. Additional information on the gap study can be found in Technical Appendix D.

Washington Street Northbound

Gaps between vehicles along Washington Street northbound traffic were measured at the intersection of Washington Street with the NEMC Emergency Entrance in order to evaluate the availability of effective gaps for the left-turning emergency vehicles.

Because gaps of about six seconds are typically needed to allow a left turn entry for emergency vehicles, this analysis counted the number of gaps lasting at least six seconds. Table 5.3-3

shows the number of six-second gaps during the morning and evening peak hours and for the entire 12 hours. Also shown, for comparison purposes, is the total number of left-turning vehicles and number of left-turning emergency vehicles during each period.

Table 5.3-3 – Washington Street Northbound Gap Study Results

Time	Gaps of Six Seconds or More		Number of Emergency Vehicles Turning Left	Number of Total Vehicles Turning Left
AM PEAK				
TOTAL	**140**		**4**	30
PM PEAK				
TOTAL	**136**		**2**	18
12-HOUR				
TOTAL	**2,155**		**26**	**228**

The total effective gaps are 140 and 136 during the morning and evening peak hours, respectively. As presented above, the number of left-turning vehicles – 30 (including four ambulances) during the morning peak hour, and 18 (including 2 ambulances) during the evening peak hour – are considerably less than the number of effective gaps. These findings indicate that there is sufficient access for emergency vehicles and that the NEMC portal would not impede emergency access at NEMC.

Washington Street Southbound

Gaps between vehicles along Washington Street southbound were measured in front of the proposed Silver Line NEMC portal location, in order to check for future control needs at this proposed intersection.

Since the Silver Line vehicles (traveling northbound on Washington Street) would be turning left into the portal at this intersection, field observations of existing Silver Line vehicles were made to measure the time required (the effective gap) for a vehicle to make a left turn. These field measurements, which were conducted at the intersection of Tremont Street and Temple Place, indicated that the minimum acceptable gap for Silver Line vehicles is 10 seconds.

The results of the study indicated that there are 69 gaps of 10 seconds or more, during the morning peak hours, and 52 gaps of 10 seconds or more, during the evening peak hours. During both the morning and peak hour there would be 18 Silver Line vehicles turning left into the portal. Ordinarily, if the volume of traffic projected to turn left is less than the number of effective gaps, there is adequate opportunity for left-turning vehicles and no control would be needed. In this case, the projected number of left-turning Silver Line vehicles (18) is considerably less than the number of gaps of ten seconds or more (69 in the morning peak and 52 in the evening peak).

5.3.1.4 Mitigation

The addition of the Silver Line Phase III NEMC portal will have negligible impacts to travel times, capacity and congestion at study area intersections. It should be noted that the congested intersection of Washington Street/Kneeland Street would experience a slight improvement with implementation of the NEMC portal. Furthermore, there are sufficient gaps in traffic traveling

along Washington Street for emergency vehicles to enter on Nassau Street and for Silver Line vehicles to enter the portal without any delays. Therefore, no traffic mitigation measures would be required for any of the Build Alternatives using the NEMC portal.

5.3.1.5 2018 Build Alternative – New England Medical Center

The same six intersections analyzed under the 2013 Build Alternative have been considered for analyses in the 2018 Horizon Year Alternative. Table 5.3-4 and Table 5.3-5 summarize the 2018 Horizon Year Alternative LOS analyses results at the unsignalized and signalized intersections, respectively.

The analysis indicates that the LOS condition for unsignalized intersections in the 2018 Build scenario would be the same as the 2013 Build scenario. All operate at acceptable LOS.

As anticipated, there is an increase in delays at study area intersections due to background traffic growth and traffic associated with other future projects, unrelated to the Silver Line. The LOS for the Washington/Kneeland Street intersection would decrease in the morning peak hour from LOS C to LOS D. However, this intersection was projected to have a LOS D for 2013 No-Build, compared to a LOS C for the 2013 Build. The LOS at other intersections would remain the same.

5.3.1.6 Parking

On-street parking impacts associated the NEMC portal would be limited to the taking of four spaces on the west side of Washington Street. The project will maintain the existing parking on the east side of Washington Street. The portal and the tunnel alignment between Washington Street and Tremont Street would also eliminate approximately 14 off-street parking spaces at the Doubletree Hotel. The MBTA would work with the Doubletree Hotel to develop a mitigation plan for the lost spaces.

In addition, approximately 80 spaces in the Auto Parks lot would be eliminated. This facility operates under a short-term lease with the BRA, which has identified this site for future development. Since the parking is temporary use and alternate public parking facilities are available in close proximity (e.g. the NEMC garage), no mitigation for the loss of this parking is anticipated. The MBTA will work with the BRA to accommodate a future air rights development over the portal consistent with BRA's long range plans for the site. (See Section 5.12 for additional information).

Table 5.3-4 – 2018 Build Alternative Unsignalized Intersection LOS Analysis Results for the New England Medical Center Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Washington St. and Nassau St./ Doubletree Hotel Entrance/Exit						
Washington St. Northbound, Left Turn	0.01	8.8	A	0.01	9.0	A
Washington St. Southbound, Left Turn	0.06	9.8	A	0.05	9.3	A
Nassau Street	0.03	18.5	C	0.01	16.4	C
Doubletree Hotel Entrance/Exit	0.03	112.9	C	0.02	21.1	C
Washington St. and Silver Line Portal						
Washington St. Northbound, Left Turn	0.05	14.0	B	0.05	15.0	B
Silver Line Portal	0.07	18.8	C	0.08	20.0	C

Source: URS / DMJM+HARRIS, Joint Venture, 2005.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle for a particular movement (s) in seconds.
LOS = Level of Service.

Table 5.3-5 – 2018 Build Alternative Signalized Intersection LOS Analysis Results for the New England Medical Center Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Washington St. and Kneeland St./Stuart St.		37.4	D		**70.7**	**E**
Eastbound, Left	**0.92**	**80.0**	**E**	0.65	33.9	C
Eastbound, Thru	0.96	47.4	D	**1.21**	**123.9**	**F**
Westbound, Left	0.70	28.3	C	0.71	29.6	C
Westbound, Thru	0.73	19.7	B	0.47	17.7	B
Northbound, Thru	0.86	43.1	D	0.62	29.3	C
Washington St. and Oak St.		12.5	B		28.6	C
Eastbound, Thru	0.80	35.0	C	**0.98**	**65.1**	**E**
Northbound, Thru	0.72	7.5	A	0.55	10.5	B
Southbound, Thru	0.17	6.0	A	0.26	15.8	B
Washington St. and Marginal St.		23.4	C		24.0	C
Westbound, Thru	0.28	23.8	C	0.35	34.2	C
Northbound, Left	0.63	18.1	B	0.40	16.1	B
Northbound, Thru	0.63	17.7	B	0.40	15.6	B
Southbound, Thru	0.38	37.1	D	**0.50**	**59.8**	**E**
Southbound, Right	**0.92**	**79.0**	**E**	**0.88**	**74.0**	**E**
Washington St. and Herald St.		40.8	D		24.0	C
Eastbound, Left	0.42	32.3	C	0.52	43.5	D
Eastbound, Thru	0.57	15.1	B	0.83	23.7	C
Westbound, Right	**1.17**	**110.0**	**F**	0.83	30.5	C
Northbound, Thru	0.48	17.7	B	0.34	18.5	B
Northbound, Right	0.04	15.7	B	0.10	18.1	B
Southbound, Thru	0.07	0.0	A	0.06	0	A

Source: URS / DMJM+HARRIS, Joint Venture, 2005.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

5.3.2 Columbus Avenue Portal

The Columbus Avenue portal is associated with the Columbus Avenue alignment alternative, which would eliminate westbound traffic on Columbus Avenue between Arlington and Berkeley Streets. Silver Line operations with a portal on Columbus Avenue would include a total of 12 inbound vehicles per hour from Dudley on Berkeley Street and six inbound vehicles per hour on Columbus Avenue entering the portal. (See Chapter 3 for additional discussion of surface routes). Silver Line operations would represent a very small fraction of the traffic volume on these streets (which are existing MBTA bus routes), and are not anticipated to result in any impacts to traffic. Therefore, the traffic analysis focuses on those intersections in the vicinity of the Columbus Avenue portal that would be expected to experience a change in traffic operations as a result of the elimination of the westbound travel lanes on Columbus Avenue between Arlington and Berkeley Streets. Traffic associated with proposed developments in the area (Columbus Center and The Clarendon), as well as Silver Line vehicle operations are incorporated into the 2013 Build volumes and LOS analysis.

This section describes the results of the 2013 No-Build, Build and 2018 Build LOS analysis for the Columbus Avenue portal. Proposed intersection improvements and access issues are also discussed.

5.3.2.1 Street Layout and Portal Location

Figure 3.4-11 illustrates the proposed street layout at the Columbus Avenue portal. The overall right-of-way on Columbus Avenue is approximately 81 feet. Two existing westbound traffic lanes and a parking lane on the north side of Columbus Avenue between Arlington Street and Berkeley Street would be taken out of service and become the ramp for the Columbus Avenue Portal. The ramp section and associated parapet walls require approximately 34 feet of the Columbus Avenue right-of-way. The sidewalk on the north side of Columbus Avenue remains unchanged. A 1-foot shoulder, two 11-foot eastbound travel lanes, an 8-foot parking lane, and an 8-foot sidewalk will comprise the rest of the street cross section. A bulb-out at the northeast quadrant of the Berkeley Street/Columbus Avenue intersection will need to be cut back to allow outbound buses to turn on to Berkeley Street

5.3.2.2 Access Impacts & Mitigation

The Columbus Avenue portal would affect access to the buildings located along the north side of the Columbus Avenue block between Berkeley and Arlington (see Figure 5.3-4). Pedestrian access to these buildings would not be impeded, but the portal would affect loading, services and other functions.

The Columbus Avenue Alternative creates a portal and boat section within the Columbus Avenue roadway, between Arlington Street and Berkeley Street. The abutting land uses are a parking lot (155 Columbus Avenue) associated with the Salvation Army Headquarters Building and building (147 Columbus Ave) housing Benjamin Franklin Smith Printers. The boat walls obstruct access to the driveway to the Salvation Army parking lot and the loading dock for the printing business. The Salvation Army Headquarters Building also has an interior parking/maintenance area located at the basement level that is accessed via a ramp through the building. The ramp has a curb cut located on Columbus Avenue, approximately 40 feet west of the end of the boat wall, in the area proposed as the Silver Line vehicle mode change area. Access to this ramp will be eliminated with implementation of the Columbus Avenue Alternative. A new access ramp would be provided from the new access on Stuart Street (see Figure 5.3-4).

Adjacent to the Benjamin Franklin Smith Printers is 139 Columbus Avenue, housing Baron Baptiste Yoga. Pedestrian access would be maintained, but there are would be no vehicle access at this building entrance. Flash's Cocktails, at 135 Columbus, has its main entrance on Stuart Street, but does have a service entrance on Columbus Avenue. Both of these businesses would need to relocate their service activity to their Stuart Street entrances.

The impacts to 155 and 147 Columbus Avenue would require mitigation, which could be accomplished through access mitigation or relocation assistance. Access to off-street parking and loading docks from Columbus Avenue for the Salvation Army Headquarters Building (155 Columbus Avenue) and Benjamin Franklin Smith Printers (147 Columbus Avenue) that would be lost as a result of implementation of the Columbus Avenue Alternative would be replaced with a new access from Stuart Street (See Figure 5.3-4). The one-story building at 320 Stuart Street would be removed to create an access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drive. If property were acquired, it would be in accordance with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Polices Act of 1970, as amended and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property.

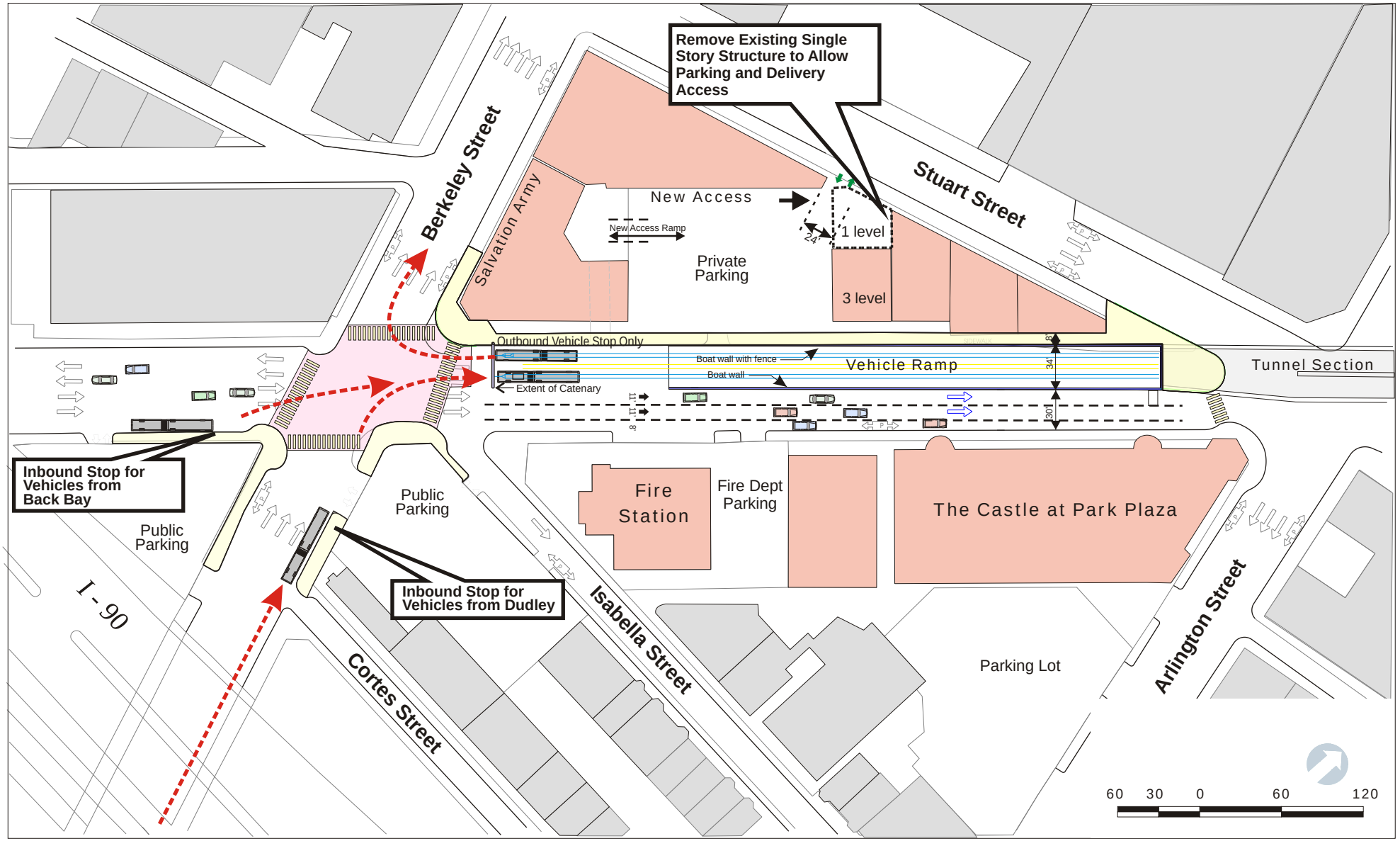


Figure 5.3-4
Columbus Avenue Portal
Potential Access Impacts

5.3.2.3 2013 Traffic Volumes and Intersection LOS Analysis Results

This section describes the future traffic conditions with and without the implementation of the Phase III Silver Line Project. Under the 2013 Build condition, traffic from the Park Plaza area that would have used Columbus Avenue westbound between Arlington and Berkeley Streets is assumed to utilize St. James Avenue to Clarendon Street to access points west on Columbus Avenue. Tables 5.3-6 and 5.3-7 summarize the 2013 No-Build Alternative and Build Alternative LOS Analyses results at the unsignalized and signalized intersections, respectively for the Columbus Avenue study area. See Figures 5.3-5 and 5.3-6 for additional information.

Table 5.3-6 – 2013 Unsignalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	2013 No-Build			2013 Build		
	V/C	Delay	LOS	V/C	Delay	LOS
Morning Peak Hour						
Berkeley Street/Cortes Street Westbound, Right	0.07	11.1	B	0.10	11.3	B
Evening Peak Hour						
Berkeley Street/Cortes Street Westbound, Right	0.14	11.0	B	0.31	12.6	B

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

Table 5.3-7 – 2013 Signalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	2013 No-Build			2013 Build		
	V/C	Delay	LOS	V/C	Delay	LOS
Morning Peak Hour						
Arlington St./St. James Ave/ Park Plaza		13.0	B		13.7	B
Eastbound, Right	0.20	36.1	D	0.19	35.5	D
Westbound, Left/Thru	0.83	34.1	C	0.33/0.82	28.3/33.8	C/C
Southbound, Thru/Right	0.51	4.8	A	0.52	4.9	A
Arlington St./ Stuart St./ Columbus Ave.		**61.5**	**E**		44.3	D
Eastbound, Thru/Right	**1.03**	**72.5**	**E**	0.91/0.64	42.1/36.6	D/D
Southbound, Left	**1.14**	**100.9**	**F**	0.79	42.7	D
Southbound, Thru/Right	0.79	28.1	C	0.79	31.5	C
Northeast bound, Thru/Right	**1.04**	**76.2**	**E**	**0.98**	**66.9**	**E**
Southwest bound, Left	0.21	26.3	C	**0.79**	**81.2**	**F**
Southwest bound, Thru	0.27	30.0	C	-	-	-
Berkeley St./Columbus Ave.		42.7	D		45.8	D
Northbound	**1.04**	**59.5**	**E**	**1.04**	**60.0**	**E**
Northeast bound, Left/Thru	0.67	20.2	C	0.52	16.4	B
Southwest bound, Thru/Right	0.23	11.6	B	0.05	10.2	B
Berkeley St./Stuart St.		22.7	C		31.9	C
Eastbound, Left/Thru	0.63	30.7	C	0.67	30.3	C
Northbound, Thru/Right	0.86	16.0	B	0.84	33.2	C
Berkeley St./St. James Ave.		22.9	C		25.1	C
Westbound, Thru/Right	0.51	18.1	B	0.59/0.20	19.4/14.2	B/B
Northbound	0.96	25.0	C	0.97	29.0	C

Location	2013 No-Build			2013 Build		
	V/C	Delay	LOS	V/C	Delay	LOS
Clarendon St./Columbus Ave.		20.8	C		19.9	B
Southbound, Left	0.61	16.9	B	0.56	10.3	B
Southbound, Thru/Right	0.52	16.5	B	0.59	10.4	B
Northeast bound, Thru/Right	0.55	22.7	C	0.63	33.2	C
Southwest bound, Left/Thru	0.50	27.0	C	0.27	33.7	C
Clarendon St./Stuart St.		18.7	B		23.2	C
Eastbound, Thru	0.63	24.3	C	0.65	24.9	C
Eastbound, Right	0.59	26.0	C	0.64	28.7	C
Southbound, Left/Thru	0.81	12.1	B	0.93	20.7	C
Clarendon St./ St. James Ave.		24.6	C		22.0	C
Westbound, Left/Thru	0.60	18.2	B	0.82/0.82	26.7/22.6	C/C
Southbound, Thru/Right	0.92	30.2	C	0.92	30.4	C
Evening Peak Hour						
Arlington St./St. James Ave./ Park Plaza		26.7	C		34.4	C
Eastbound, Right	0.34	24.0	C	0.34	24.2	C
Westbound, Left/Thru	**1.02**	**61.8**	**E**	0.46/**1.09**	28.6/**81.9**	C/F
Southbound, Thru/Right	0.50	8.4	A	0.51	8.5	A
Arlington St./Stuart St./ Columbus Ave		**90.0**	**F**		**62.5**	**E**
Eastbound, Thru/Right	**1.21**	**125.7**	**F**	0.95/0.94	47.7/52.5	D/D
Southbound, Left	**1.01**	**65.6**	**E**	0.91	54.9	D
Southbound, Thru/Right	0.98	45.6	D	0.91	39.5	D
Northeast bound, Thru/Right	**1.54**	**207.2**	**F**	**1.25**	**139.9**	**F**
Southwest bound, Left	0.72	31.5	C	**0.91**	**76.9**	**E**
Southwest bound, Thru	0.66	33.3	C	**-**	**-**	**-**
Berkeley St./ Columbus Ave.		49.7	D		38.2	D
Northbound	0.97	43.2	D	1.01	53.5	D
Northeast bound, Left/Thru	**1.13**	**78.1**	**E**	0.78	18.8	B
Southwest bound, Thru/Right	0.36	9.8	A	0.05	9.8	A
Berkeley St./ Stuart St.		21.9	C		27.0	C
Eastbound, Left/Thru	0.81	30.5	C	0.92	34.2	C
Northbound, Thru/Right	0.86	14.9	B	0.78	20.7	C
Berkeley St./ St. James Ave.		15.2	B		20.3	C
Westbound, Thru/Right	0.80	22.5	C	0.94/0.60	33.4/18.7	C/B
Northbound	0.86	11.7	B	0.87	12.9	B
Clarendon St./ Columbus Ave.		38.0	D		31.0	C
Southbound, Left	0.84	31.8	C	0.82	27.7	C
Southbound, Thru/Right	0.72	30.6	C	0.93	28.2	C
Northeast bound, Thru/Right	0.70	41.9	D	0.82	45.2	D
Southwest bound, Left/Thru	0.78	52.7	D	0.30	2021	C
Clarendon St./ Stuart St.		20.6	C		42.0	D
Eastbound, Thru	0.52	21.0	C	0.56	22.5	C
Eastbound, Right	0.48	21.6	C	0.55	23.3	C
Southbound, Left/Thru	0.90	20.1	C	1.10	54.4	D
Clarendon St./ St. James Ave.		43.6	D		**55.2**	**E**
Westbound, Left/Thru	0.69	14.7	B	1.04/1.05	49.3/49.0	D/D
Southbound, Thru/Right	**1.13**	**80.9**	**F**	**1.09**	**66.4**	**E**

Source: URS / DMJM+HARRIS, Joint Venture, 2004.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

As expected, the 2013 No-Build analysis indicates that the LOS at most of the signalized intersections would deteriorate over existing conditions due to an increase in background traffic unrelated to the Silver Line. The LOS at the Arlington Street/Stuart Street/Columbus Avenue intersection is projected to fail in the morning (LOS E) and evening (LOS F) peak hours.

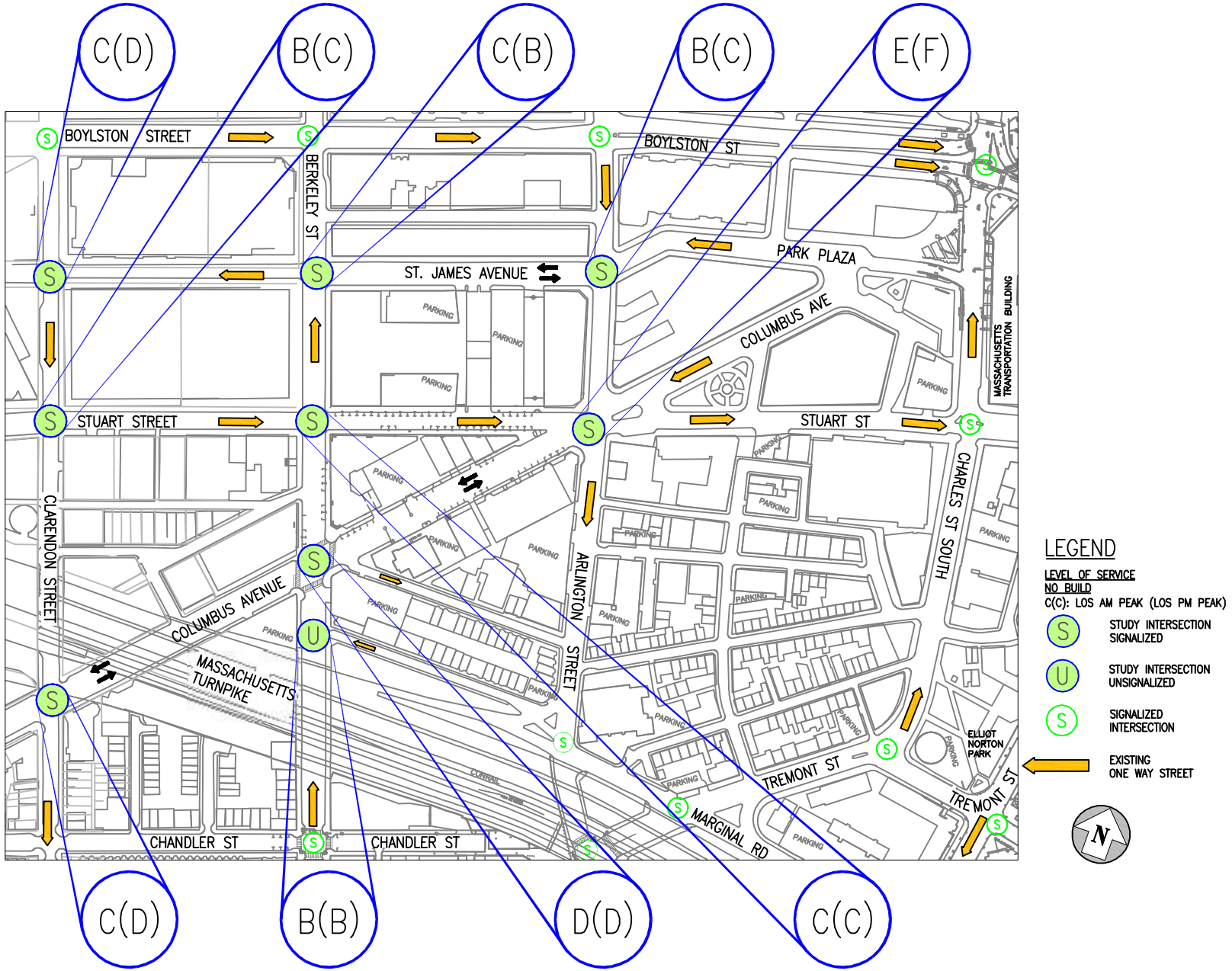


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Figure 5.3-5
2013 Columbus Avenue Portal
No-Build LOS

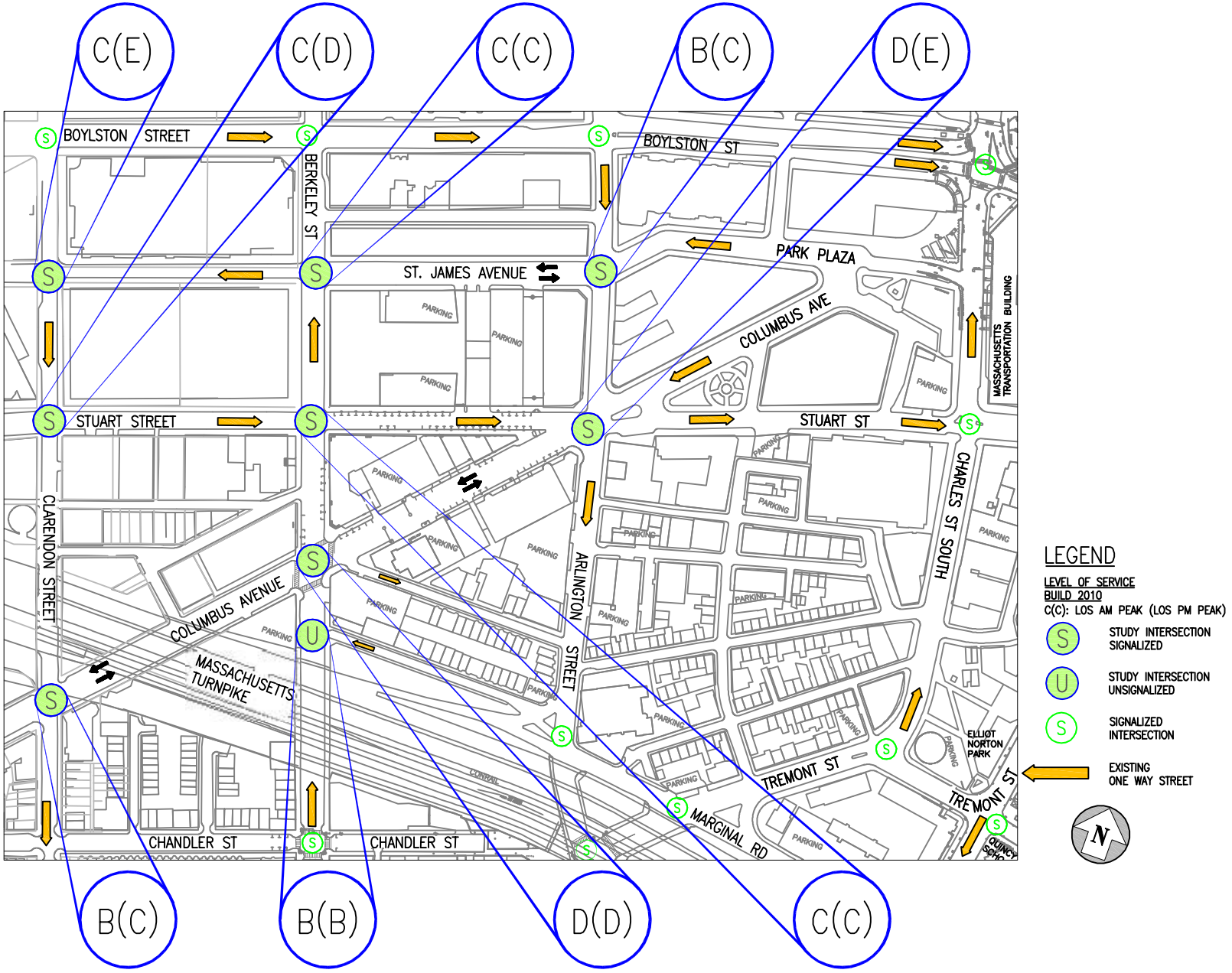

Figure 5.3-6
2013 Columbus Avenue Portal Build LOS

The 2013 Build Analysis indicates that a majority of the intersections improve over the 2013 No-Build conditions, but two intersections (Arlington Street/Stuart Street/Columbus Avenue and Clarendon Street/St. James Avenue) would operate with congestion. The LOS at two intersections would improve during the morning peak hour (Arlington Street/Stuart Street/Columbus Avenue and Clarendon Street/Columbus Avenue), and deteriorate at one intersection (Clarendon Street/Stuart Street). In the evening peak hour, the LOS at two intersections would improve (Arlington Street/Stuart Street/Columbus Avenue and Clarendon Street/Columbus Avenue) and deteriorate at three intersections (Berkeley Street/St. James Avenue, Clarendon Street/Stuart Street and Clarendon Street/St. James Avenue). The intersection of Arlington Street/Stuart Street/Columbus Avenue would improve compared to the No-Build – from an E to a D in the morning peak hour, and from an F to an E in the evening peak hour. The elimination of the westbound lane on Columbus Avenue between Arlington and Berkeley eliminates one of the moves at this intersection, resulting in an improved LOS. The intersection of Berkeley and Columbus would remain a LOS D in the morning and evening peak hour periods.

In addition to affecting intersection LOS, the Columbus Avenue Alternative would affect overall local area circulation needs with resulting traffic increases and corresponding delays along the following routes:

- Park Plaza/St. James Avenue from Columbus Avenue to Clarendon Street
- Clarendon Street from St. James Avenue to Columbus Avenue
- Cortes Street from Arlington Street to Berkeley Street

Local egress/circulation at Park Plaza will be affected, with westbound trips destined for Columbus Avenue diverted onto Park Plaza/St. James Avenue. Other local trips that cannot conveniently access this route will use Arlington Street and Cortes Street to connect back to Columbus Avenue.

Traffic Safety

The consistently high accident history and poor LOS at the intersection of Arlington Street/Stuart Street/Columbus Avenue indicates a potential area of concern under the No-Build condition. The closure of westbound Columbus Avenue to accommodate the proposed portal for the Columbus Avenue Alternative provides an opportunity to improve safety at the intersection through roadway layout and signal phasing improvements.

Emergency Vehicles

As described in Chapter 3, the location of the portal on Columbus Avenue and proposed Silver Line operations are not anticipated to substantially affect operations at the Boston Fire Department station located on the corner of Columbus Avenue and Isabella Street. The current fire pre-empt signal operation would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue. Fire trucks returning to the station would be restricted to entering eastbound only. This would add some travel time for return routes that currently use Columbus Avenue westbound.

Mitigation

Signal improvements would be implemented to maintain acceptable LOS at the intersection of Berkeley/Columbus.

Proposed intersection improvements at the Arlington/Columbus/Stuart (see Figure 5.3-7) intersection would improve LOS from the No-Build, from LOS E/F to LOS D/E and also improve traffic and pedestrian safety. Improvements at the intersection of Arlington Street/Stuart Street/Columbus Avenue do not eliminate current and future delays and congestion along the Columbus eastbound and Stuart Street southbound approaches to the intersection. Alternative routing for proposed Silver Line surface routes to Washington Street that avoid this intersection are being considered.

5.3.2.4 2018 Build Alternative – Columbus Avenue

The 2018 Horizon Year examines the traffic conditions in the study area five years after completion of the Silver Line Phase III project. Tables 5.3-8 and 5.3-9 summarize the 2018 Horizon Year Alternative LOS analyses results at the unsignalized and signalized intersections, respectively.

Table 5.3-8 – 2018 Build Alternative Unsignalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	Morning Peak Hour			Evening Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS
Berkeley Street/Cortes Street Westbound, Right	0.10	11.6	B	0.34	13.0	B

Source: URS / DMJM+HARRIS, Joint Venture, 2005
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

The analysis indicates the same LOS B condition as the No-Build for the one unsignalized intersection, with slightly longer delays (one to two seconds) for right turns.

Compared to the 2013 Build, one intersection would deteriorate in the morning peak hour (Clarendon Street/Columbus Avenue), and three in the evening peak hour (Arlington/St. James/Park Plaza; Berkeley/St. James and Clarendon Street/Stuart Street). The intersection of Arlington, Stuart and Columbus would remain the same, although some of the movements would deteriorate.

5.3.2.5 Parking

The Columbus Avenue Alternative will eliminate the following on-street parking:

- 12 spaces along the north side of Columbus Avenue between Arlington and Berkeley Streets;
- Loss of metered parking spaces during peak periods along the north side of St. James Avenue between Arlington and Berkeley Streets;
- 2 to 3 parking spaces along the north side of Park Plaza east of Arlington Street would be eliminated;

Table 5.3-9 – 2018 Build Alternative Signalized Intersection LOS Analysis Results for Columbus Avenue Portal

Location	2013 Build LOS	2013 Build LOS	Morning Peak Hour			Evening Peak Hour		
	Morning Peak Hour	Evening Peak Hour	V/C	Delay	LOS	V/C	Delay	LOS
Arlington St./ St. James Ave./ Park Plaza	B	C		13.7	B		39.7	D
Eastbound, Right	D	C	0.20	35.0	D	0.36	24.9	C
Westbound, Left/Thru	C/C	C/**E**	0.34/0.84	28.0/33.7	C/C	0.48/**1.15**	28.8/**97.6**	C/**F**
Southbound, Thru/Right	A	A	0.55	5.0	A	0.53	8.6	A
Arlington St./ Stuart St./ Columbus Ave.	D	**E**		49.3	D		**71.3**	**E**
Eastbound, Thru/Right	D/D	D/D	0.93/0.65	44.8/36.4	D/D	0.98/0.97	53.0/57.3	D/D
Southbound, Left	D	D	0.85	49.5	D	**0.98**	**65.2**	**E**
Southbound, Thru/Right	C	D	0.86	35.4	D	0.98	48.7	D
Northeast bound, Thru/Right	**E**	**F**	**1.3**	**77.8**	**E**	**1.31**	**155.1**	**F**
Southwest bound, Left	**E**	**E**	**0.82**	**86.3**	**F**	**0.96**	**86.5**	**F**
Berkeley St./ Columbus Ave.	D	D		50.1	D		45.9	D
Northbound	**E**	D	**1.06**	**65.2**	**E**	**1.06**	**66.7**	**E**
Northeast bound, Left/Thru	B	B	0.56	18.9	B	0.82	19.5	B
Southwest bound	B	A	0.05	10.7	B	0.05	9.8	A
Berkeley St./ Stuart St.	C	C		31.9	C		30.4	C
Eastbound, Left/Thru	C	C	0.71	31.8	C	0.96	40.04	D
Northbound, Thru/Right	C	C	0.87	32.0	C	0.83	21.8	C
Berkeley St./ St. James Ave.	C	B		31.6	C		23.8	C
Westbound, Thru/Right	B/B	C/B	0.60/0.20	19.7/14.3	B/B	0.99/0.63	39.7/19.6	D/B
Northbound	C	B	0.99	39.3	D	0.92	15.0	B
Clarendon St./ Columbus Ave.	B	C		21.5	C		32.5	C
Southbound, Left	B	C	0.58	10.7	B	0.86	27.8	C
Southbound, Thru/Right	B	C	0.61	10.9	B	0.98	28.4	C
Northeast bound, Thru/Right	C	D	0.68	37.5	D	0.86	51.3	D
Southwest bound, Left/Thru	C	C	0.29	34.7	C	0.32	20.4	C
Clarendon St./ Stuart St.	C	D		24.5	C		**57.3**	**E**
Eastbound, Thru	C	C	0.70	26.7	C	0.60	23.9	C
Eastbound, Right	C	C	0.69	31.5	C	0.59	24.5	C
Southbound, Left/Thru	C	D	0.54	21.2	C	**1.14**	**79.0**	**E**
Clarendon St./ St. James Ave.	C	**E**		29.4	C		**74.0**	**E**
Westbound, Left/Thru	C/C	D/D	0.86/0.86	31.1/25.8	C/C	**1.09/1.10**	**64.3/66.**9	**E/E**
Southbound, Thru/Right	C	**E**	0.97	31.4	C	**1.15**	**88.4**	**F**

Source: URS / DMJM+HARRIS, Joint Venture, 2005.
Notes: V/C = Volume to Capacity ratio.
Delay = Average stopped delay per vehicle in seconds.
LOS = Level of Service.

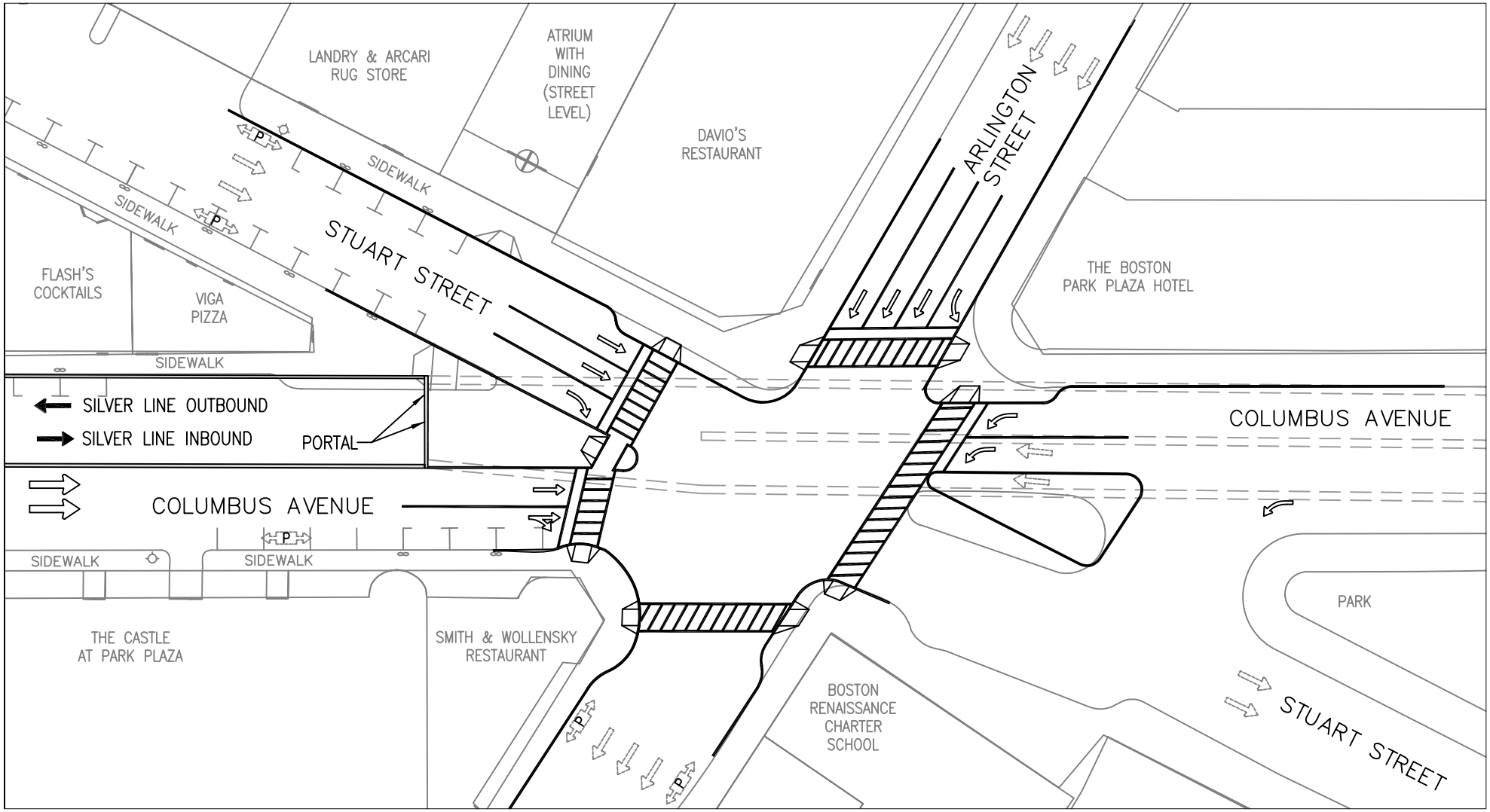

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Figure 5.3-7
Columbus Avenue Portal Intersection Improvements

5.3.3 Mitigation Summary

The addition of the Silver Line Phase III NEMC portal would have negligible impacts to travel times, capacity and congestion at study area intersections. It should be noted that the congested intersection of Washington Street/Kneeland Street would experience a slight improvement with implementation of the NEMC portal. In addition, an exclusive left-turn lane for Silver Line vehicles would be provided on Washington Street to manage access to the portal. Sidewalk and pedestrian safety measures would be installed in the vicinity of the portal.

The addition of the Columbus Avenue Alternative would not cause an increase in congestion or travel delays over 2013 No-Build conditions. However, traffic signal modifications would be implemented at the Berkeley Street/Columbus Avenue intersection to maintain an acceptable LOS for this urban environment. In addition, proposed intersection improvements at the Arlington Street/Columbus Avenue/Stuart Street intersection (see Figure 5.3-7) would improve LOS from the 2013 No-Build (from LOS E/F to LOS D/E) and also improve traffic and pedestrian safety. Improvements at the intersection of Arlington Street/Stuart Street/Columbus Avenue do not eliminate current and future delays and congestion along the Columbus eastbound and Stuart Street southbound approaches to the intersection. Alternative routing for proposed Silver Line surface routes to Washington Street that avoid this intersection are being considered.

The current fire pre-empt signal operation would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue (westbound fire trucks will be allowed to utilize the available bus lanes).

Lastly, the Columbus Avenue portal would affect access to the buildings located along the north side of the Columbus Avenue block between Berkeley and Arlington. Pedestrian access to these buildings would not be impeded, but the portal would affect loading, services and other functions. A new access drive for the Salvation Army Parking lot would be provided from Stuart Street. The one-story building at 320 Stuart Street would be removed to create the access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drive. This new access drive would also lead to a new ramp for access to the parking under the Salvation Army (see Figure 5.3-4).

5.4 Transit, Pedestrian, and Bicycle

Any urban mass transit system creates pedestrian traffic during peak periods and the Silver Line Phase III project has proposed pedestrian improvements at the NEMC and Columbus Avenue portals. In addition, the impact of additional pedestrian traffic resulting from the project was assessed at proposed Silver Line Phase III stations, Boylston Street and Chinatown, and the proposed portal locations. All pedestrian crossing locations are currently signalized, striped, accessible, and have sufficient queuing space for anticipated increases in pedestrians. The goal of the project is to safely and efficiently accommodate multimodal users, and to rationalize access and connections from Silver Line stops to nearby facilities or destinations.

5.4.1 Chinatown and Boylston Street

Boylston Street and Chinatown stations are located in a dense commercial urban environment, with connections to existing transit service: The Green Line at Boylston Station and the Orange Line at Chinatown Station. There is, therefore, considerable pedestrian activity at both of these locations. The sidewalks in these areas, designed to accommodate large volumes of pedestrians, operate at a LOS A, and would continue to do so in the future (See Table 5.4-1).

In order for the Silver Line Phase III project to negatively affect the LOS (reduce LOS from A to E) in these locations, a very large number of pedestrians would have to be added (See Table 5.4-1). As a result of the Silver Line Phase III, the additional pedestrians on the surface will not approach the volumes required to have congested sidewalks or crosswalks.

Table 5.4-1 – Chinatown and Boylston Station Pedestrian Volumes, 2013

Location	No-Build		Additional Pedestrian Volumes Required to reach LOS C	Additional Pedestrian Volumes Required to reach LOS E
	Peak Hour	Peak Hour		
Chinatown Station	**7:45 AM – 8:45 AM**			
Boylston St./Essex St./Washington St.[1]				
Washington South (West Side)	728	A	2,422	5,685
Washington South (East Side)	997	A	1,943	4,988
Boylston Station	**5:00 PM – 6:00 PM**			
Boylston St./Tremont St.[2]				
Tremont St South	939	A	1,056	3,336
Tremont St North	1,063	A	932	3,212
Boylston St West	865	A	1,445	3,838
Boylston St East	1,169	A	2,223	6,100
Boylston St./Charles St.[2]	**5:00 PM – 6:00 PM**			
Charles St South	636	A	1,758	4,494
Charles St North	764	A	4,696	10,936
Boylston St West	369	A	2,571	5,616
Boylston St East	250	A	3,740	8,300

Notes:
1. 2001 pedestrian counts from the Liberty Place Draft Project Impact Report, December 2001, were inflated by 2% annually.
2. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, September 2004, were inflated by 2% annually.

5.4.1.1 Bicycle Accommodations

Chinatown Station is underground and little space is available at the highly congested street level areas for bicycle racks, maps, or bicycle storage lockers. More space is available around the Boylston Street Station on the north side of the street (Boston Common side) where bicycle racks are provided. A wide sidewalk and plaza areas around the existing Green Line headhouses present additional opportunities to locate bicycle facilities. The provision of bicycle racks at bus rapid transit stops is standard design and the MBTA will work with the Boston Traffic Department to determine the proper location and types of bicycle racks to be added in the area.

5.4.2 New England Medical Center Portal

The NEMC area is a complex pedestrian environment with a number of important pedestrian destinations, including the New England Medical Center, and an Orange Line station. Peak hour pedestrian activity occurs between 7:45 AM and 8:45 AM. Sidewalks on both sides of Washington Street are heavily used by a variety of pedestrians: school-aged children, elderly, NEMC staff and their patients and visitors, neighborhood residents of all ages, and the occasional theater-goer or hotel guest. At Washington Street, where a Silver Line surface station is planned

within the portal ramps, both pedestrians and automobiles using Washington Street will encounter transit vehicles entering and exiting traffic from an area which is currently a hotel parking lot with low levels of vehicle activity. Additionally, pedestrians will have to cross the new 35-foot wide portal driveway opening serving the transit vehicles.

A number of improvements would combine to mitigate risks to pedestrians from transit operations (see Figure 5.4-1). Sidewalks on the west side of Washington Street in the vicinity of the portal driveway opening are currently 13 feet wide and will be widened to 16 feet or more as a parking lane is being removed. The extra width will help to increase pedestrian safety. Pedestrian signals could help to improve pedestrian safety. Pedestrian signals that include animated "moving eyes" (the animated eyes look left and right to remind pedestrians that they need to look left and right) have been shown in studies to increase pedestrian awareness to vehicle movements that are concurrent with crossing phases. Warning strips and bollards can also improve pedestrian safety (see Figure 5.4-2). Tactile warning strips call attention to dangerous edge conditions through contrasting color and texture. Warning strips can aid the pedestrian who may only be looking down at the pavement and is not aware of flashing signals. Bollards are commonly used to physically separate vehicle traffic from heavily-used pedestrian areas. They can also make pedestrians aware of the boundaries in a mixed zone of pedestrian and vehicular traffic. Combined with tactile warning strips and audio/visual signals, bollards are an effective tool to increase pedestrian awareness. Continuous pavements (sidewalk pavements that carry across streets and visually connect both sides) form visual cues to the driver that the pedestrian zone extends into the traveled way (see Figure 5.4-3 for examples of continuous pavement).

The Doubletree Hotel at 821 Washington Street has an entrance approximately 100 feet south of the surface station. There is an existing parking and drop off area for the hotel between the hotel entrance and the surface station, and the hotel would be buffered from the surface station by new landscaping and ornamental fencing. Currently, there is an existing transit station 200 feet north of the hotel on Washington Street where the MBTA Orange Line NEMC/South Cove Station entrance is located. Establishing a new station 100 feet from the hotel would increase the amount of pedestrian activity on sidewalk areas near the hotel. However, the predominant pedestrian traffic is anticipated to come from transfers from the Orange Line and the NEMC facility, located to the north of the hotel where there would be less bus traffic on the surface as a result of Silver Line Phase III.

With the future Silver Line operations, a higher number of pedestrian movements will occur at the Silver Line vehicle stops located in the portal. Pedestrians would have to walk a few more feet than they do today between the crosswalk at NEMC and the portal in order to reach the Silver Line platforms and vice versa. A pedestrian crosswalk would be located at the portal entrance (west side of Washington Street) in order to facilitate pedestrian movement to and from the bus stop location (in the portal). Improvements to the crosswalk in front of the NEMC parking garage ramps will increase pedestrian safety.

As a mitigation measure to address pedestrian mobility and safety, the section of Washington Street extending from Nassau Street (emergency entrance to NEMC and main entrance to Doubletree Hotel) to the signalized crosswalk at the main entrance of NEMC, would have a pedestrian-friendly environment and be implemented with pedestrian safety features. For example, it is important to have a continuity of the pedestrian walkway from the NEMC crosswalk to the portal passing in front of the NEMC garage and the portal itself. The uniformity of pavement is a signal to vehicles that they are in a pedestrian environment. At the portal connection to Washington Street, equipment such as audible signals, flashing lights, textured warning pavements and bollards would be installed where the sidewalk crosses the garage and the portal exits as a warning for pedestrians when a car/Silver Line vehicle is exiting (see Figure 5.4-2 and 5.4-3). Well-designed pedestrian lighting is important for safety. The roadway in front of the portal and parking garage exits could also be equipped with traffic calming features with the objective of encouraging lower vehicle speeds. Traffic calming features would have to be designed around the needs of emergency vehicles.

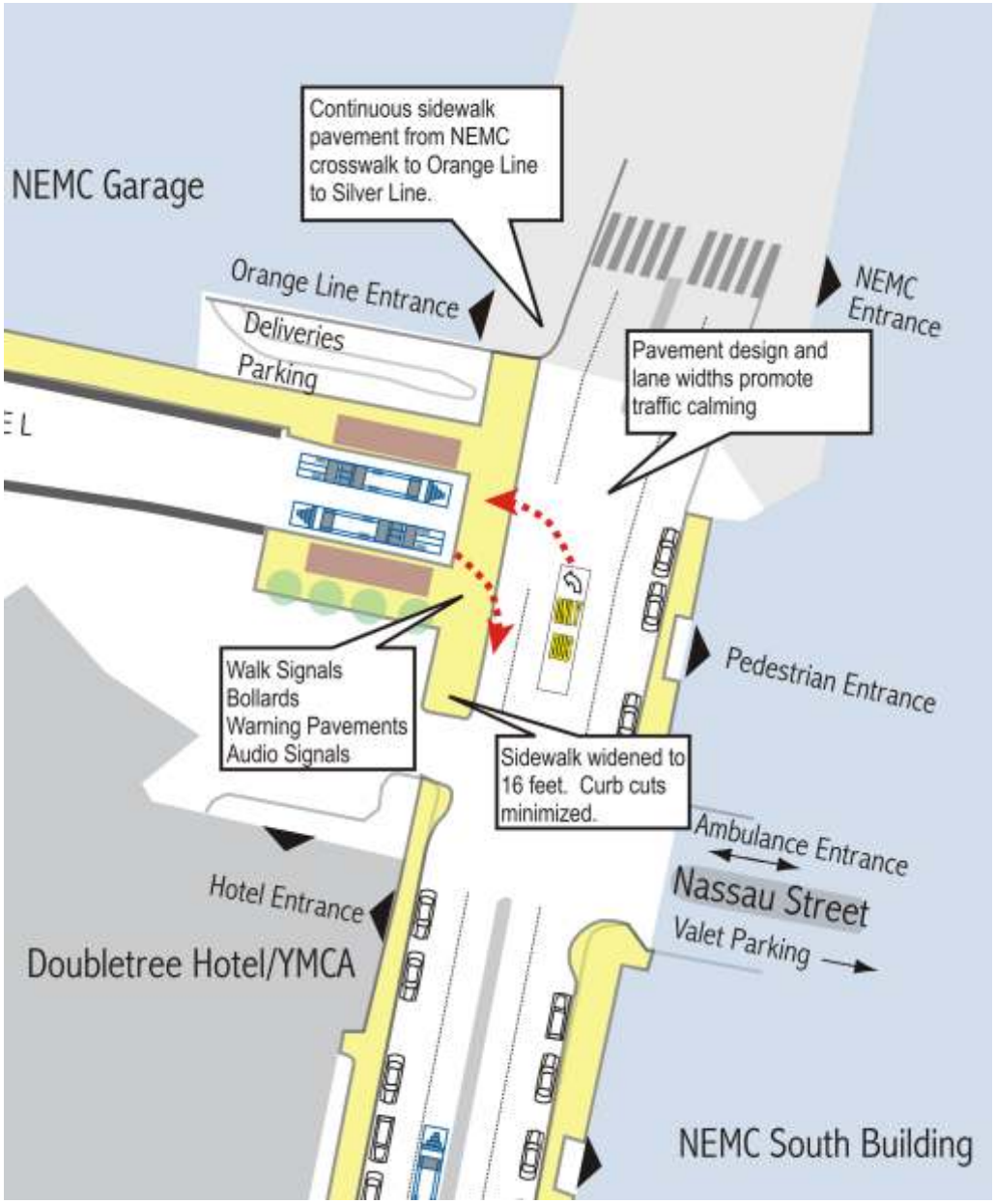

Figure 5.4-1
NEMC Portal
Proposed Pedestrian Environment

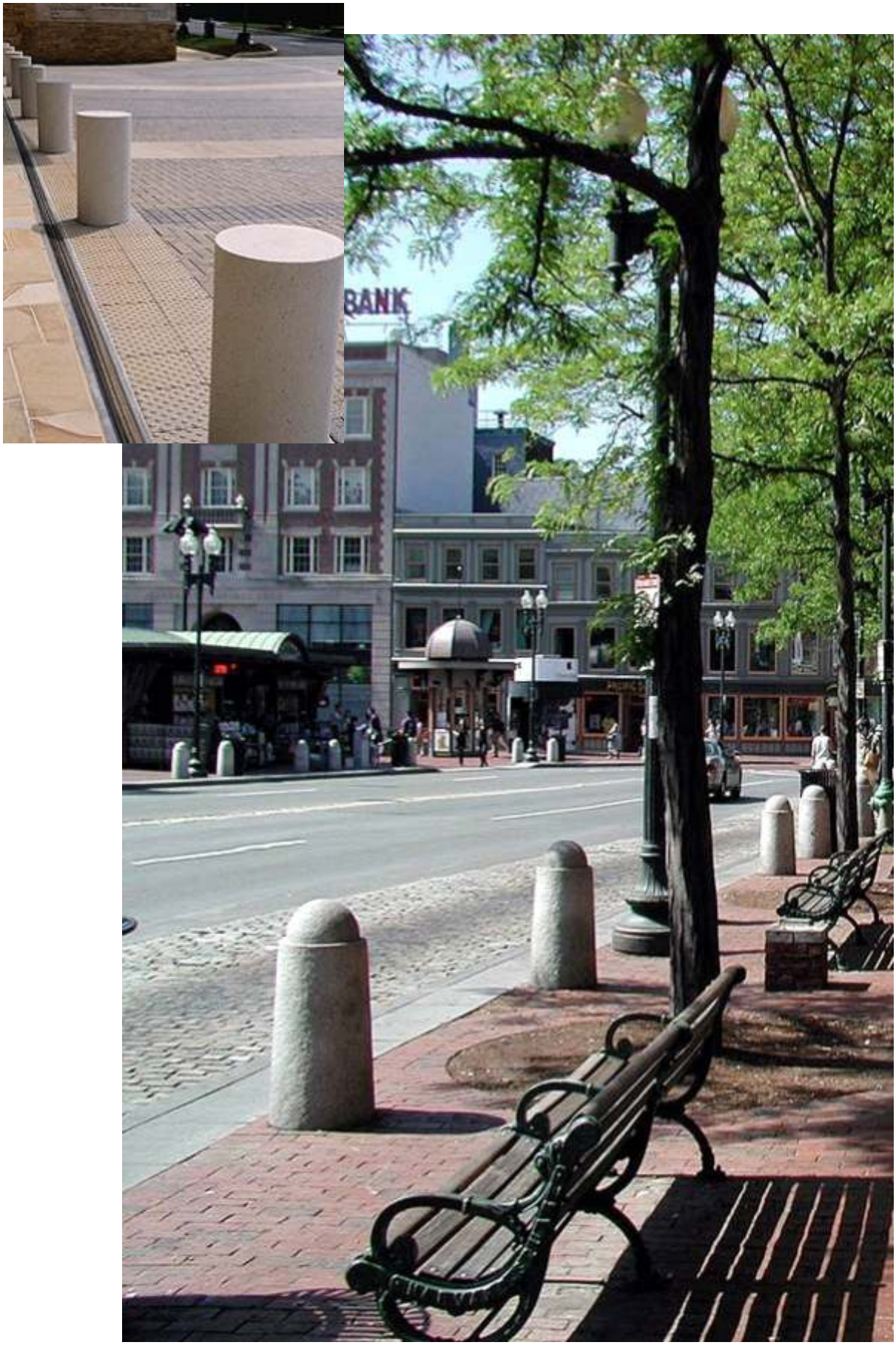

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Figure 5.4-2
Bollards and Warning Strips

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Figure 5.4-3
Continuous Pavement

If pedestrian activity continues to increase, area sidewalks would still function at LOS A (see Table 5.4-2). Pedestrian counts were taken in 2004 to describe the existing pedestrian conditions around the NEMC portal and these numbers were used to project the future (2013) pedestrian conditions. It is estimated that an additional 600 pedestrians would be using the sidewalks and crosswalks surrounding the NEMC portal, during the peak hour, as a result of Silver Line Phase III service. In the context of the large volumes of pedestrians required to negatively affect LOS in this area, additional pedestrian activity resulting from the NEMC portal alternatives would be minimal.

Table 5.4-2 – NEMC Portal Pedestrian Volumes, 2013

Location	No-Build		Additional Pedestrian Volumes Required to Reach LOS C	Additional Pedestrian Volumes Required to Reach LOS E
	Peak Hour[1]	LOS		
NEMC Portal [2]				
NEMC Crosswalk from East	262	A	1,733	4,013
Orange Line/Garage from West	1,11	A	884	3,164
Washington Street Sidewalk South	63	A	3,192	6,777
Washington Street Sidewalk North	57	A	4,332	9,348

Notes:
1. Peak hour is 7:45 to 8:45 AM
2. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, May 2004, were inflated by 2% annually.

5.4.2.1 Bicycle Accommodations

The status of bicycle mobility will not be affected by the Silver Line bus operations especially if the street in the portal vicinity is equipped with features addressing vulnerable users' safety. The provision of bicycle racks at bus rapid transit stops is standard design and the MBTA will work with the Boston Transportation Department to determine the proper location and types of bicycle racks to be added in the area.

5.4.3 Columbus Avenue Portal

The Columbus Avenue portal would be available in existing traffic lanes adjacent to a city sidewalk on the north side of Columbus Avenue. The sidewalk would be resurfaced and lit. Between the sidewalk and the portal boat section would be a low parapet wall with an ornamental fence separating pedestrians from the bus electrification system. Columbus Avenue between Arlington and Berkeley Streets has existing sidewalk access on the north and south sides interrupted by curb cuts for driveways. The proposed portal and bus ramp would retain these sidewalks and improve the sidewalk surface on the north side. Adjacent to the bus ramp on the north side, pedestrians would walk by several hundred feet of parapet wall and fencing. Fencing is required to separate pedestrians from gaining access to the overhead electrified trolley wires as they emerge from the tunnel. Pedestrian improvements in the area of the intersection between Columbus and Berkeley streets would consist of improved sidewalks, crosswalks and intersection pavement to promote traffic calming (See Figures 5.4-2 though 5.4-4 for examples).

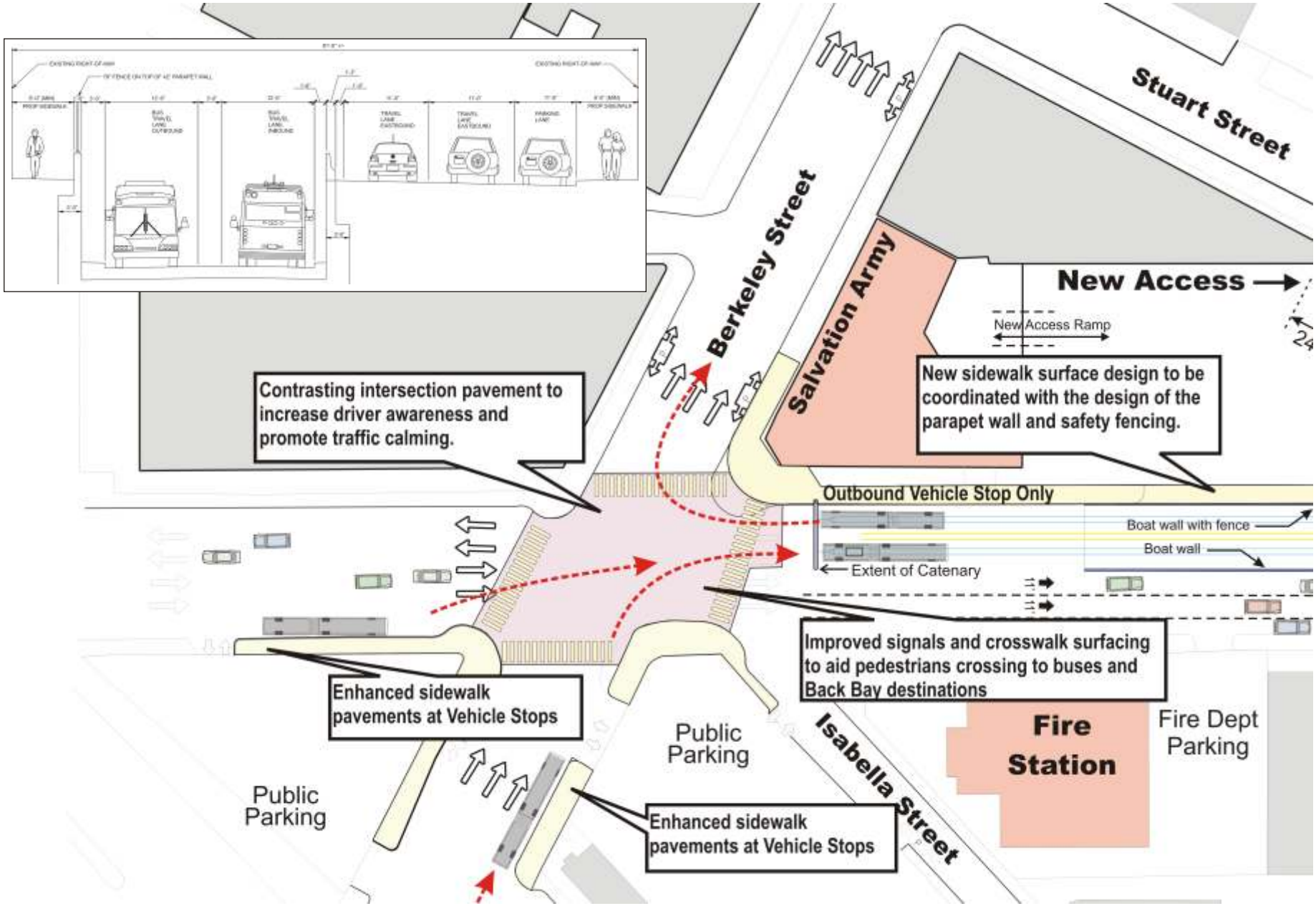

Stuart Street
Berkeley Street
Salvation Army
New Access
New Access Ramp
Contrasting intersection pavement to increase driver awareness and promote traffic calming.
New sidewalk surface design to be coordinated with the design of the parapet wall and safety fencing.
Outbound Vehicle Stop Only
Boat wall with fence
Boat wall
Extent of Catenary
Improved signals and crosswalk surfacing to aid pedestrians crossing to buses and Back Bay destinations
Enhanced sidewalk pavements at Vehicle Stops
Public Parking
Isabella Street
Fire Station
Fire Dept Parking
Public Parking
Enhanced sidewalk pavements at Vehicle Stops

Figure 5.4-4
Columbus Avenue Portal
Proposed Pedestrian Environment

Improvement to the intersection and four street corners of the Columbus Avenue/Berkeley Street intersection would be installed to create a pedestrian-friendly environment. Contrasting pavements would be used through the intersection as a traffic calming measure and to increase driver awareness. Where bus stops are located on three of the five legs of the intersection, well-designed crosswalks, properly timed pedestrian signals, and clear signing would be installed for pedestrian safety and mobility.

There is adequate sidewalk space to accommodate pedestrians near the Columbus Avenue portal now and into the future at LOS A (see Table 5.4-3). In order to assess potential impacts on pedestrian LOS at this portal, the pedestrian projections used at the NEMC portal – 600 additional pedestrians during the peak hour – were used. These projections represent a conservative estimate for Columbus Avenue because it does not have the same high-traffic generating land uses as NEMC. Because the number of additional pedestrians does not approach the large volumes needed to negatively affect LOS, there would be no impact.

Table 5.4-3 – Columbus Portal Pedestrian Volumes, 2013

Location	No-Build		Additional Pedestrian Volumes Required for LOS C	Additional Pedestrian Volumes Required for LOS E
	Peak Hour	LOS		
Columbus Ave/Berkeley St. [1]	**8:00 AM – 9:00 AM**			
Columbus Ave North	463	A	1,532	3,812
Columbus Ave South	279	A	1,716	3,996
Berkeley St West	160	A	2,780	5,825
Berkeley St East	270	A	2,922	6,570
Arlington St/Columbus Ave/Stuart St [2]	**5:00 PM – 6:00 PM**			
Arlington St South	417	A	2,875	6,636
Columbus Ave Southwest	341	A	1,654	3,934
Stuart St West	329	A	3,063	6,940
Arlington St North	288	A	3,004	6,765
Columbus Ave Northeast	210	A	1,785	4,065
Stuart St East	161	A	3,231	7,108

Notes:

1. 2009 Build Analysis from the Clarendon Draft Project Impact Report, June 2004, inflated by 2% annually.
2. 2004 pedestrian counts conducted by Transportation Data Corporation for Silver Line Phase III, September 2004, inflated by 2% annually.

5.4.3.1 Bicycle Accommodations

Bicycle mobility will not be affected by Silver Line bus operations especially if the street in the portal vicinity is equipped with traffic calming features addressing vulnerable users' safety. The MBTA will work with the Boston Traffic Department to determine the proper location and types of bicycle racks to be added in the area.

5.5 Air Quality

5.5.1 Introduction

This section describes the anticipated impact of the Silver Line Phase III alternatives on air quality at the regional level and within the project area. Air quality analyses have been ongoing over the last several years and have been previously presented in the Annual Updates and Notices of Project Change since the FEIS/FEIR for the Transitway was completed in 1993. (See Chapter 2 for additional information.) The analysis presented in this SDEIS/EIR assesses the impacts for the full Silver Line project through Phase III, extending from Dudley Square through downtown Boston to the South Boston Waterfront and Logan Airport, also addressing the impacts of alternative portal locations at either the NEMC or Columbus Avenue. The analysis is presented in three parts: a mesoscale analysis that addresses changes in pollutant emissions for all criteria pollutants at the regional level; a microscale analysis that addresses localized CO levels and the potential for CO hotspots in the vicinity of the alternative portal locations; and, a localized analysis of changes in total emissions of all criteria pollutants produced by transit operations within the entire Silver Line project area.

5.5.2 Mesoscale Analysis

As discussed in Section 3.6, the Central Transportation Planning Staff (CTPS) prepared ridership forecasts for the Silver Line Phase III using the regional travel demand model that was used to develop the region's Transportation Plan and travel impact analyses for the region's various planned transportation projects. For these forecasts, certain network assumptions were made to reflect current service plans including the Silver Line Phase III tunnel. Using the regional model, CTPS calculated changes in travel behavior and diversion of auto trips to transit as a result of the availability of new transit services for each phase of Silver Line operation. This analysis produced roadway link-level travel data accounting for vehicle miles of travel and average link speeds. In order to assess changes in regional mobile source emissions, these data were used in conjunction with emission factors produced by CTPS, using EPA's MOBILE6H emission factor model. The emission factor model is calibrated for Massachusetts-specific conditions in each of the forecast years to incorporate current and predicted vehicle fleet characteristics and the implementation of various emission control programs such as enhanced vehicle inspection and maintenance (I/M). The results of this analysis are shown below in Table 5.5-1.

Table 5.5-1 – Daily Regional Impacts of Phase III Operations

2025 Alternative	CO (pounds)	NOx (pounds)	VOC (pounds)	VMT	VHT
No-Build	1,962,909	48,325	47,752	106,131,900	3,366,200
Baseline	1,962,689	48,325	47,752	106,117,500	3,365,600
Baseline-No-Build	**-220**	**0**	**0**	**-14,400**	**-600**
NEMC Portal (Tremont, Charles, and Stuart Street Alternatives)	1,962,116	48,303	47,730	106,088,500	3,363,800
NEMC - Baseline	**-794**	**-22**	**-22**	**-43,400**	**-2,400**
Columbus Ave Portal	1,962,050	48,303	47,730	106,085,600	3,363,300
Columbus - Baseline	**-860**	**-22**	**-22**	**-46,300**	**-2,900**

Source: Central Transportation Planning Staff
Note: Based on MOBILE 6H emission factors for 2025.
CO assumes winter rates while VOC & NOx assume summer emission rates.

Note that the regional impacts for all alternatives which would utilize the NEMC portal are the same because projected ridership, as well as auto diversions for each alignment are comparable. As indicated in the table, diversions of trips from auto to transit result in a significant reduction in daily regional vehicle miles of travel, thereby producing regionwide air quality benefits as a result of reduced emissions of NOx, CO, and VOC.

5.5.3 Microscale Analysis

The microscale analysis is the component of the overall air quality impact analysis that focuses on the localized (rather than regional) changes in ambient air quality conditions that may occur with the implementation of the various Silver Line alternatives. The pollutant addressed through the microscale analysis is CO which is produced primarily through transportation exhaust emissions and can potentially create localized "hot spots" in areas of high traffic congestion. The NAAQS for CO are:

- 35.0 parts per million (ppm) for a one-hour averaging period, not to be exceeded more than once per year

- 9.0 ppm for a consecutive eight-hour averaging period, not to be exceeded more than once per year

A microscale analysis was conducted for the earlier 1993 FEIS/FEIR which involved the screening of 25 intersections throughout the study area and detailed analysis at five of these intersections which exhibited sufficient delay and congestion to potentially represent air quality problem areas. Based on this previous detailed analysis, none of the analyzed intersections were found to exceed NAAQS for CO.

For the purpose of this SDEIS/EIR, an assessment was made of traffic operations at intersections in the vicinity of the NEMC and Columbus Avenue portals. Four intersections on Washington Street affected by Silver Line Phase III operations in proximity to the NEMC portal were initially analyzed to determine future peak hour traffic volumes, level of service, and vehicle delay. These intersections are Washington at Kneeland, Oak, Marginal, and Herald (see Figure 5.3.-3). Of these intersections, Washington at Kneeland was found to have the highest average vehicle delay and Washington at Herald was found to have the highest peak hour vehicle throughput volume. Therefore these two intersections were selected as locations for the CO microscale analysis based on the premise that if these locations did not exceed NAAQS, then those locations with better traffic conditions (based on total volumes, level of service, and vehicle delay) would also not exceed NAAQS. In the area of the proposed Columbus Avenue portal, the intersections of Arlington Street and Stuart Street at Columbus Avenue and Clarendon Street at St. James Avenue were selected for analysis, also based on total throughput volumes and level of service (See Figure 5.3-6). Similarly, it is assumed that if these locations did not exceed NAAQS, then those locations with better traffic conditions would also not exceed NAAQS.

The modeling process used in microscale analysis involves the application of two models approved by EPA. The MOBILE6H model is used to generate emission factors representative of vehicle operating conditions for a given analysis year, reflecting control technologies in effect at that time, vehicle fleet characteristics, and vehicle operating speeds. These emission factors are then incorporated into the CAL3QHC dispersion model which estimates pollutant concentrations near intersections by accounting for emissions of both freely-flowing vehicles and vehicles idling in queues at traffic signals.

Analysis of the intersections was conducted for year 2013, reflecting the full build opening year condition for the Silver Line Phase III and were based on peak hour conditions as determined through traffic counts and an analysis of traffic operations derived from the CTPS regional travel model. To determine whether the eight-hour standard might also be exceeded, a persistence

factor of 0.6 was applied to the results of the one-hour analysis. The persistence factor takes into account that over eight hours, traffic parameters will fluctuate downward from the peak and meteorological conditions will vary, as compared to one-hour values. This analysis assumed background concentrations of 2.8 ppm for the one-hour analysis and 1.7 ppm for the eight-hour analysis as derived from Massachusetts Department of Environmental Protection monitoring data.

The results of the microscale analysis of year 2013 one-hour conditions are shown in Table 5.5-2 and for eight-hour conditions in Table 5.5-3. As indicated in these tables, no violations of either the one-hour or eight-hour NAAQS for CO are predicted to occur at any of the analyzed locations. Based on this analysis, it can be concluded that no violations of the NAAQS for CO would occur throughout the area affected by Silver Line operations.

Table 5.5-2 – Estimated Year 2013 Worst Case One-Hour CO Concentrations (ppm)

Standard: 35 ppm

Intersection	Receptor Location	Peak Hour	
		Wind Angle	CO Conc.
With NEMC Portal:			
Washington/	NW Corner	180	3.6
Kneeland	NE Corner	0	3.9
	SW Corner	280	4.1
	SE Corner	230	3.7
Washington/	NW Corner	160	3.9
Herald	NE Corner	90	4.0
	SW Corner	270	3.9
	SE Corner	220	3.9
With Columbus Ave. Portal:			
St. James/	NW Corner	110	4.4
Clarendon	NE Corner	70	4.3
	SW Corner	340	4.5
	SE Corner	190	4.2
Arlington/	NW Corner	40	4.2
Stuart/	W Corner	20	4.2
Columbus	NE Corner	10	4.1
	SW Corner	350	4.2
	SE Corner	320	4.4

Note: Assumes background of 2.8 ppm (from South Boston Piers/Fort Point Channel Transit Project Social, Economic and Environmental Impacts Assessment Report, November, 1992 and confirmed through discussion with Massachusetts Department of Environmental Protection, January 10, 2005).

Table 5.5-3 – Estimated Year 2013 Worst Case Eight-Hour CO Concentrations (ppm)
Standard: 9 ppm

Intersection	Receptor Location	Peak Hour	
		Wind Angle	CO Conc.
With NEMC Portal:			
Washington/	NW Corner	180	2.2
Kneeland	NE Corner	0	2.4
	SW Corner	280	2.5
	SE Corner	230	2.2
Washington/	NW Corner	160	2.4
Herald	NE Corner	90	2.4
	SW Corner	270	2.4
	SE Corner	220	2.4
With Columbus Ave. Portal:			
St. James/	NW Corner	110	2.7
Clarendon	NE Corner	70	2.6
	SW Corner	340	2.7
	SE Corner	190	2.5
Arlington/	NW Corner	40	2.5
Stuart/	W Corner	20	2.5
Columbus	NE Corner	10	2.5
	SW Corner	350	2.5
	SE Corner	320	2.7

Note: Assumes persistence factor of 0.6 and a background of 1.7 ppm (from South Boston Piers/Fort Point Channel Transit Project Social, Economic and Environmental Impacts Assessment Report, November, 1992 and confirmed through discussion with Massachusetts Department of Environmental Protection, January 10, 2005).

5.5.4 Emissions of Transit Operations

In order to assess the relative change in emissions produced by transit vehicles in the Silver Line service area as a result of the completion of Silver Line Phase III, an analysis of transit vehicle emissions was performed which accounts for service changes and new vehicle technologies. This analysis assesses the total emissions produced by each vehicle mode resulting from the Phase III service configuration. These emissions are compared to a Baseline scenario which accounts for emissions from the Phase II Silver Line service in 2005, prior to construction and operation of the Phase III tunnel. All other MBTA services are assumed to remain unchanged.

Both the Baseline and Phase III scenarios involve implementation of services that would be provided by a dual mode vehicle, meaning that it will operate in a zero-emitting electric mode in tunnel segments and with clean diesel-powered GenSet operations while on surface streets. (See Section 3.5.3.1 for a more detailed description of this vehicle.) Therefore this analysis separately accounts for the vehicle's two modes of operations: electric and GenSet. It is also assumed that the Phase I Dudley to Downtown Crossing/Temple Place service, which does not operate in tunnel, will continue to utilize CNG buses in Phase III. Information about the specific operation of the dual mode and CNG buses is provided in Section 3.5 of this report.

Each scenario in this analysis assumes operation in 2013 of the following services and modes:

Baseline

- Silver Line Phase I – Dudley to Downtown Crossing (CNG)
- Silver Line Phase II – South Station to BMIP (Dual Mode)
- Silver Line Phase II – South Station to City Point (Dual Mode)
- Silver Line Phase II – South Station to Logan Airport (Dual Mode)
- Silver Line Phase II – South Station to BCEC and Andrew Station via D Street (Dual Mode)
- Silver Line Phase II – South Station to Silver Line Way (Dual Mode)
- Silver Line Phase II – Back Bay (Dalton Street) to Downtown Crossing (Dual Mode)

Full Build (Phase III)

- Silver Line – Dudley to Logan Airport (Dual Mode)
- Silver Line – Dudley to Silver Line Way (Dual Mode)
- Silver Line – Dudley to Downtown Crossing/Temple Place (CNG)
- Silver Line – Back Bay (Dalton Street) to Silver Line Way (Dual Mode)
- Silver Line – Boylston to Logan (Dual Mode)
- Silver Line – Boylston to BMIP (Dual Mode)
- Silver Line – Boylston to City Point (Dual Mode)
- Silver Line – Boylston to BCEC and Andrew Station via D Street (Dual Mode)
- Silver Line – Boylston to Silver Line Way (Dual Mode)

Table 5.5-4 shows the vehicle miles of travel generated by transit operations and the resulting transit-related emissions for each scenario. Emission factors for each mode were based on rates provided by the vehicle manufacturers. Vehicle miles of operation for each mode were provided by CTPS. Because Silver Line vehicles will operate in zero-emitting electric mode in tunnel, the differences among Build Alternatives are due to alternative portal locations. As indicated, with the exception of NOx emissions, total emissions attributable to transit operations decrease in each of the build scenarios due to the reduction in surface operations involving CNG vehicles and greater utilization of electric traction. There is also a significant increase in overall transit service, with total transit VMT in the full build scenario increasing over 50 percent in comparison to the No-Build scenario.

TABLE 5.5-4 – VEHICLE MILES OF TRAVEL BY MODE AND TOTAL TRANSIT EMISSIONS

ALTERNATIVE	Total VMT by Mode			Total	Total Emissions (lbs. per day)			
	CNG	Electric	Genset	VMT	CO	VOC	NOx	PM10
NO-BUILD	860	1038	2126	4024	47.2	8.6	167.5	0.6
COLUMBUS PORTAL	447	2766	2898	6111	40.3	5.7	192.2	0.7
NEMC PORTAL	337	2788	2846	5971	36.2	4.7	183.7	0.7

This increase in transit service also results in a decrease in overall regional emissions of criteria pollutants, including NOx, as a result of diversions of auto trips to transit. Table 5.5-5 illustrates the overall net benefit resulting from the implementation of Silver Line service by subtracting the increase in transit emissions from the calculated change in regional emissions shown in Table 5.5-4.[4] The resulting change in overall emissions indicates the significant air quality benefits achieved through the implementation of Phase III Silver Line services under any of the Build Alternatives.

[4] Note that changes in PM-10 emission rates were not calculated by CTPS at the regional level.

TABLE 5.5-5 – CHANGES IN NET REGIONAL EMISSIONS

ALTERNATIVE	Emissions (lbs. per day)			
	CO	VOC	NOx	PM10
COLUMBUS PORTAL	-867	-25	3	NA
NEMC PORTAL	-805	-26	-6	NA

5.6 Noise and Vibration

This section provides a discussion of noise and vibration impacts associated with operation of the Silver Line Phase III Build Altnernatives. Construction period impacts are discussed in Chapter 6. (See Technical Appendix G for additional discussion.)

5.6.1 Noise

As discussed in Section 4.6, noise from aboveground operations of the BRT vehicles was assessed using methodology contained in the FTA Manual.

5.6.1.1 Core Tunnel Segment

The Core Tunnel Segment portion of the project would not have any operational noise impacts from the BRT vehicles because the entire segment would be below ground. The motive power for the buses while underground would be from electric motor, which would be considerably quieter than the diesel engine mode used for power above-ground. The rubber-tired buses would produce some tire/tunnel-floor interaction noise, but this noise would be contained within the tunnel and not transmitted to the surface.

Additionally, tunnel and station ventilation shaft/fan noise were evaluated for potential noise effects for the project. Ventilation system operation would be continuous for the two stations (Boylston Station and Chinatown Station) along the Core Tunnel Segment. The fans and motors for the ventilation systems would be housed at platform level, and noise attenuation would be an integral part of them. Each fan would be equipped with modular sound attenuators at both the inlet and discharge sides of the fan, and additional sound attenuation would be provided as needed such that noise levels from the ventilation systems would not exceed Boston noise standards or the *Guidelines for Design of Rapid Transit Facilities* (American Public Transit Association (APTA), 1981.) Similarly, emergency ventilation fans and vents are a part of the station and tunnel design, located at intervals of approximately one every 500 feet along the alignment. Emergency vent fans would only operate as-needed or during periodic testing or maintenance. The emergency ventilation systems would be designed in the same fashion as the station ventilation systems to meet or exceed City and APTA noise standards. Thus, with the design standards as proposed for the ventilation systems, no noise impacts are anticipated.

5.6.1.2 NEMC Portal

The NEMC portal study area for noise impacts includes private dwellings, hospitals and hotels in the nearby area. The existing ambient noise levels at each of the noise-sensitive receptors in the vicinity of the portal area were estimated from the noise levels measured at adjacent or representative long-term measurement sites. Based upon the data provided and utilizing the methodology in the FTA Manual, the resultant noise levels (in terms of L_{dn}) were derived for the project. Table 5.6-1 summarizes the estimated noise levels at the nearby noise-sensitive land uses from the two major components of BRT noise (i.e., with the buses in motion and while at

slow speed and idling near the portal in the process of changing modes – diesel to electric or vice-versa). Based upon FTA noise impact criteria, all five of the noise-sensitive receptors analyzed result in "No Impact".

Table 5.6-1 – NEMC Portal Noise Analysis Results - Build

Noise-Sensitive Receptor	Nominal Source / Receptor Distance (Feet)	Existing Ambient Noise Level (dBA L_{dn})	BRT Transit Noise (Electric Mode) (dBA L_{dn})	BRT Transit Noise (Diesel Mode) (dBA L_{dn})	Combined Noise Level (Both Modes) (dBA L_{dn})	Degree of Impact (No Impact, Impact, Severe Impact)
Doubletree Hotel	100	70	52	58	59	No Impact
New England Medical Center	100	70	52	58	59	No Impact
Townhouses on Lyndeboro Place	100	75	52	58	59	No Impact
South Cove Plaza Residences	200	75	47	54	54	No Impact
Elliot Norton Park	150	75	49	55	56	No Impact

A comparable analysis to that described above was conducted for the No-Build Alternative. Under the No-Build Alternative, bus traffic that would otherwise enter and exit the tunnel portal at Washington Street from the south would otherwise continue along Washington Street to points north. The results of that analysis are summarized in Table 5.6-2. Comparison of the results of the No-Build Alternative with the Build Alignment Alternative indicates that bus-related noise levels are predicted to be slightly lower under the No-Build Alternative at the Lyndeboro Place townhouses located to the north of Elliot Norton Park, the South Cove Plaza residences and at Elliot Norton Park, but slightly higher at the Doubletree Hotel and the New England Medical Center. However, based upon FTA noise impact criteria, all five of the noise-sensitive receptors analyzed result in "No Impact".

Table 5.6-2 – NEMC Portal Noise Analysis Results – No Build

Noise-Sensitive Receptor	Nominal Source / Receptor Distance (Feet)	Existing Ambient Noise Level (dBA L_{dn})	BRT Transit Noise (Electric Mode) (dBA L_{dn})	BRT Transit Noise (Diesel Mode) (dBA L_{dn})	Combined Noise Level (Both Modes) (dBA L_{dn})	Degree of Impact (No Impact, Impact, Severe Impact)
Doubletree Hotel	75	70	--	60	60	No Impact
New England Medical Center	75	70	--	60	60	No Impact
Townhouses on Lyndeboro Place	575	75	--	47	47	No Impact
South Cove Plaza Residences	425	75	-	49	49	No Impact
Elliot Norton Park	500	75	--	48	48	No Impact

5.6.1.3 Columbus Avenue Portal

BRT noise from the Columbus Avenue Alternative was analyzed at the nearest noise-sensitive land use adjacent to the alignment, near the tunnel portal. Table 5.6-3 summarizes the estimated noise levels at the nearest noise-sensitive land uses from the two major components of the BRT noise (i.e., with the buses in motion and while at slow speed and idling near the portal in the process of changing modes – diesel to electric or vice-versa). Based upon FTA noise impact criteria, the Build Alternative for the Columbus Avenue portal would not cause a noise impact at any of the four nearest noise-sensitive receptors.

Under the No Build Alternative, no project-related bus activity occurs in the Columbus Avenue portal area, thus no associated noise impacts would occur.

Table 5.6-3 – Columbus Avenue Portal Noise Analysis Results - Build

Noise-Sensitive Receptor	Nominal Source / Receptor Distance (Feet)	Existing Ambient Noise Level	BRT Transit Noise (Phase 1 - Electric)	BRT Transit Noise (Phase 2 – Diesel)	Combined Noise Level (BRT Phase 1 + 2)	Level of Impact (No Impact, Impact, Severe Impact)
Boston Renaissance Charter School	215	65 dBA L_{eq}	44 dBA L_{eq}	50 dBA L_{eq}	51 dBA L_{eq}	No Impact
Salvation Army HQ	50	65 dBA L_{eq}	--	63 dBA L_{eq}	63 dBA L_{eq}	No Impact
Ten St. James	108	65 dBA L_{eq}	52 dBA L_{eq}	--	52 dBA L_{eq}	No Impact
Fire Station, 194 Columbus Avenue	76	75 dBA L_{dn}	50 dBA L_{dn}	61 dBA L_{dn}	61 dBA L_{dn}	No Impact

5.6.2 Vibration

The potential for vibration impacts from the operational phase of the project was evaluated using the FTA's Vibration Screening Procedure. As stated in Section 9.1 of the FTA Manual, projects that involve rubber-tired vehicles are unlikely to cause vibration impacts except in unusual situations, such as irregularities in the roadway surface, the presence of vibration-sensitive manufacturing or research facilities, or buses operating inside of or directly underneath buildings of interest. Because the project involves constructing a new, underground tunnel dedicated solely to BRT use, the alignment would be free of roadway irregularities to the extent practicable. Additionally, the alignment would not be constructed near vibration-sensitive manufacturing or research equipment, and would not be constructed inside of or directly underneath vibration-sensitive buildings. Thus, no vibration impacts are anticipated from the operation of the project. NEMC was concerned about the potential vibration impacts to their sensitive Magnetic Resonance Imaging (MRI) equipment and in response to their concerns, an analysis was conducted, as described below.

5.6.2.1 NEMC Vibration Assessment

An assessment of potential vibration impacts at vibration-sensitive locations within the Tufts-New England Medical Center facility, including the MRI trailer, MRI Unit #2 in the MRI suite, the third floor clinical labs, and the fifth floor operating suite, was conducted for the NEMC portal alternatives. Based on the field measurements taken, existing ambient vibration levels at MRI Unit #2 were generally 10 decibels or more below the manufacturer's (Siemens Harmony/Symphony) vibration specification for the MRI equipment.

Existing ambient vibration levels at the third floor clinical lab and the fifth floor operating rooms were generally 10 decibels below the ISO vibration criterion for an "operating theatre". Existing vibration levels inside the MRI Trailer were approximately five to 13 decibels above the manufacturer's "steady-state"[5] vibration specification. Ambient vibration levels at the MRI trailer are dominated by the operation of a generator underneath the floor of the trailer which is used to cryogenically cool the MRI magnet.

Vibration levels at vibration-sensitive equipment from operation of the 60-foot articulated dual mode Silver Line vehicle at the NEMC portal on Washington Street are projected to be 25 decibels or more below the ISO operating criteria at the third floor clinical lab and the fifth floor operating rooms. Vibration levels at the MRI Unit are projected to be 10 decibels or more below manufacturer's specifications. Base on this analysis, no vibration impacts at vibration-sensitive locations within the Tufts-New England Medical Center facility are anticipated from Silver Line Phase III operations at the NEMC portal. (See Technical Appendix C for additional technical information on the NEMC vibration analysis.)

5.6.3 Summary and Mitigation

No noise and vibration mitigation measures are being proposed because there would be no long term impacts as a result of the Silver Line Phase III operations.

5.7 Environmental Justice

Applicable Federal policies require each agency to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority and low-income populations. As described in Section 4.3, the Silver Line Phase III corridor, as well as the full build Silver Line area[6], encompasses a number of neighborhoods, including Chinatown, the South End, and Roxbury that qualify as Environmental Justice (EJ) communities on the basis of minority population or median income. As shown in Table 4.3-2, 51.6 percent of the populated traffic analysis zones (TAZs) within the Tremont/Charles/Stuart alignment corridor, and 51.3 percent of the populated TAZs within the Columbus Avenue alignment corridor are defined as an EJ community under one or both of these criteria.

This section analyzes the potential benefits and impacts of the project on the identified EJ communities, and whether the project will have any disproportionately high and adverse human health and environmental effects on minority and low-income populations. Chapter 8 discusses in detail the public participation measures employed by the Silver Line project to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.

5.7.1 Public Outreach

As described in Section 4.3, a major goal of environmental justice policy is to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process, including identified EJ communities. A comprehensive public outreach process ensures that community needs and concerns are heard. Once these needs and concerns are known, they

5 "Steady-state" vibration specification is applicable to vibrations produced for long time intervals such as rotating machinery.

6 The full build Silver Line includes Phases I, II, and III.

can then be addressed to the extent practical in the development and design of the transportation project.

The public outreach process for the Silver Line Phase III project has been extensive and has incorporated special efforts to ensure that low-income, minority, and non-English-speaking populations are included in the process. The public outreach process for the Phase III project is described in Chapter 8.

5.7.2 Accessibility Benefits for EJ Communities

The most significant benefit of the Phase III project for the communities it serves, including EJ communities, will be improved accessibility to jobs and other major destinations, as a result of travel time savings, improved level of service, and greater travel convenience. As described in Section 4.2.2, the households in the Phase II corridor are heavily transit-dependent. The Silver Line Phase III will serve as an important connection between Phases I and II, by providing quicker and more convenient access to important employment destinations in downtown Boston and the Waterfront area.

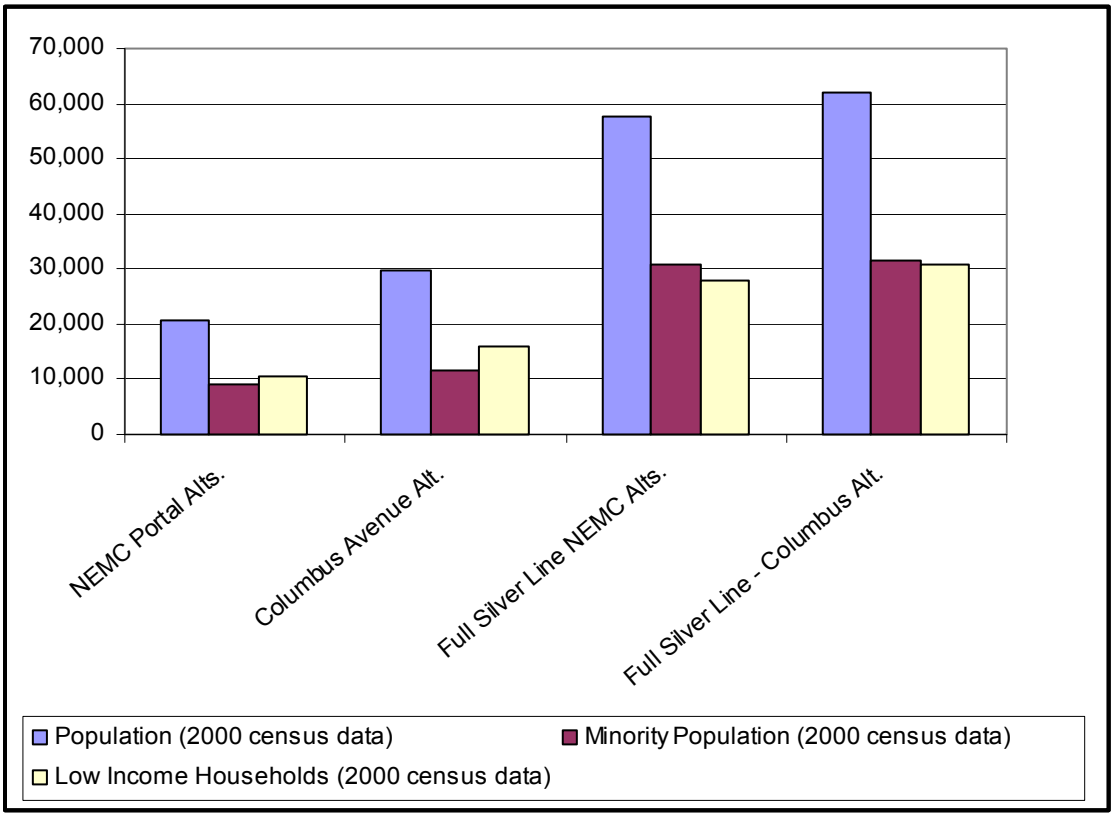
Table 5.7-1 summarizes the EJ characteristics of the population that would be served by the Silver Line Phase III Corridor alternatives and the full build Silver Line. Minority population accounts for 39 to 43 percent of the Phase III corridor population, and almost 20 percent of the corridor households have been classified as low-income households by the U.S. Census Bureau.

Table 5.7-1 – Environmental Justice Criteria – Summary of Statistics

	Total Population	Minority Population (percent)	Low-Income Households (percent)
Silver Line Phase III Tremont Street/Charles Street/Stuart Street Alternatives	20,851	8,891 (42.6%)	1,966 (18.7%)
Full Build Silver Line* Tremont Street/Charles Street Alternatives	57,630	30,711 (53.3%)	5,905 (21.0%)
Silver Line Phase III Columbus Avenue Alternative	29,899	11,600 (38.8%)	2,474 (15.7%)
Full Build Silver Line* Columbus Avenue Alternative	62,159	31,603 (50.8%)	6,126 (19.8%)

* Full Build includes Phases I, II and III of the Silver Line
Sources: U.S. Department of Commerce, United States Census 2000; CTPS.

Low Income and Minority Population



Employment – The Silver Line Phase III project, as well as the full build Silver Line, will provide access to important employment destinations, including downtown Boston, the South Boston Waterfront area, and Logan Airport. According to 2001 employment statistics from the Metropolitan Area Planning Council (MAPC), the quarter-mile catchment area for the Tremont Street/Stuart Street/Charles Street Alternatives encompasses about 33 percent of the employment in the City of Boston, accounting for 187,154 of the 572,485 jobs in the city. Employment within the catchment area for the Columbus Avenue alternative is estimated at 217,200, accounting for 38 percent of the jobs in Boston. Employment within the full build Silver Line catchment area is estimated between 267,123 and 295,699 jobs (depending on the Phase III alternative), which accounts for 45 to 52 percent of the total employment in the City of Boston (see Table 5.7-2).

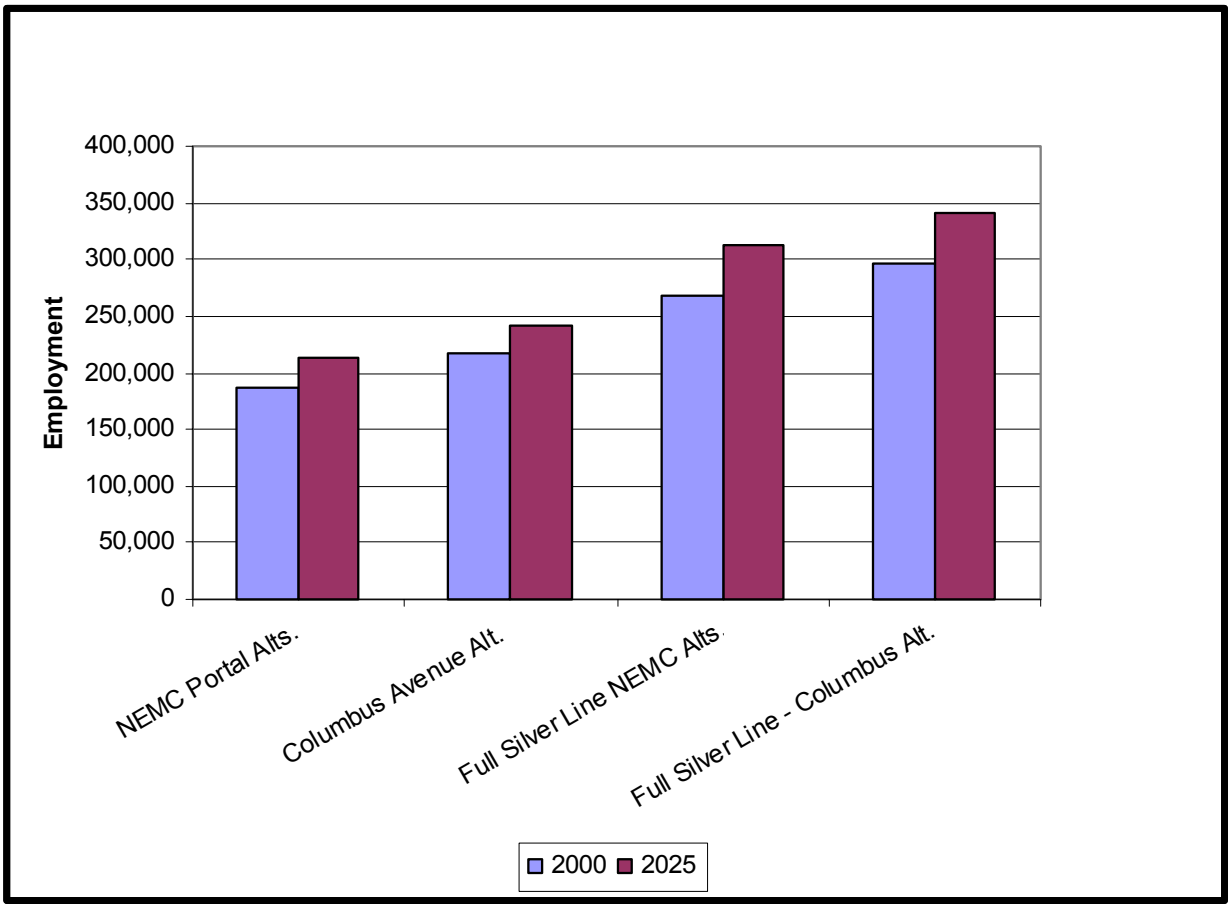
Employment growth in the Silver Line Phase III catchment area is projected at 13.4 percent and 11.6 percent between 2001 and 2025 for the Tremont Street/Charles Street/Stuart Street and Columbus Avenue Alternatives, respectively. The number of jobs within the Silver Line Phase III catchment area is estimated at 212,190 by 2025 for the Tremont Street/Charles Street/Stuart Street Alternatives, and 242,467 for the Columbus Avenue alternative. Employment growth within the Silver Line Phase III catchment area is similar to the employment growth elsewhere in the Boston region, which is projected at 12.6 percent between 2001 and 2025. Employment within the full build Silver Line area is projected between 312,115 and 341,001 by 2025, for a 15.3 to 16.8 percent increase in 24 years.

Table 5.7-2 – Socioeconomic Characteristics for the Silver Line Phase III Alternatives, Full Build Silver Line Corridor and the Boston Metropolitan Region - Employment

	2000 Employment	2025 Employment	25-year Increase
Silver Line Phase III – Tremont Street/Charles Street/Stuart Street Alternatives	187,154	212,190	13.4%
Full Build Silver Line - Tremont Street/Charles Street/Stuart Street Alternatives	267,123	312,115	16.8%
Silver Line Phase III – Columbus Avenue Alternative	217,200	242,467	11.6%
Full Build Silver Line – Columbus Avenue Alternative	295,699	341,001	15.3%
City of Boston (*2001*)	578,485*	602,124	4.1%

Sources: U.S. 2000 Census; Central Transportation Planning Staff (CTPS); Metropolitan Area Planning Council (MAPC)* Refer to year 2001 employment figures from MAPC.

Employment



Travel Time – An analysis was performed to estimate the travel time savings for EJ communities afforded by the Phase III project. This analysis examined travel between: 1) Chinatown and the

World Trade Center (WTC) in the Waterfront area; 2) Chinatown and the Financial District/South Station; 3) Dudley Square and the World Trade Center; and 4) Dudley Square and the Financial District/South Station. Both Dudley Square and Chinatown are considered EJ communities with a high concentration of low-income and minority populations. The WTC area and the Financial District/South Station are important employment generators, and, as discussed in Section 4.2, employment in the Waterfront area is projected to increase significantly by 2025.

Travel time savings per trip and total daily trips between Chinatown and the WTC, and Chinatown and the Financial District/South Station for the NEMC Portal and Columbus Avenue Portal alternatives are shown in Tables 5.7-3 and 5.7-4, respectively. The implementation of Phase III would reduce the travel time between Chinatown and the WTC by almost nine minutes for both the NEMC portal alternatives and the Columbus Avenue alternative. The NECM portal alternatives are projected to generate a total of 800 transit trips between Chinatown and the WTC in 2025, resulting in 117 hours of daily travel time savings. Likewise, the Columbus Avenue alternative is projected to generate 700 trips between this origin-destination pair, for a total daily travel time savings of 100 hours.

A trip between Chinatown and the Financial District/South Station will experience travel time reductions between 6.2 and 6.5 minutes for the Columbus Avenue and NEMC portal alternatives, respectively. Based on the total daily trips between Chinatown and the Financial District/South Station, total daily savings realized by the Silver Line Phase III implementation in 2025 are estimated between 196 and 227 hours.

As mentioned, Silver Line Phase III provides an important connection between Phases I and II. With Phase III, the travel time between Dudley Square and the WTC would be reduced by almost 10 minutes under the NEMC portal alternatives. Daily travel time savings are estimated at 264 hours, given that 1,600 transit trips are forecast to occur between this origin-destination pair. For the Columbus Avenue alternative, travel time savings between Dudley Square and the WTC are estimated at 7.7 minutes, for a total of 154 hours in travel time savings. The Columbus Avenue alternative is forecast to serve 1,200 trips between Dudley Square and the WTC by 2025.

Travel time savings between Dudley Square and the Financial District/South Station are estimated at nine minutes for the 5,000 users by 2025 of the NEMC portal alternatives, saving almost 780 hours of daily travel time (see Table 5.7-3). For the Columbus Avenue alternative, travel time savings between Dudley Square and the Financial District/South Station would be approximately six minutes for 3,900 users, saving 410 hours of travel time (see Table 5.7-4).

In addition to these travel time savings for trips destined to existing and growing employment centers, Phase III also affords travel time savings for EJ communities traveling to other key destinations the Boston region. Refer to Tables 3.6-4 and 3.6-5 for examples of other travel time savings benefits.

Table 5.7-3 – Travel Time Savings Comparison: Silver Line Phase III Build vs. Baseline: Tremont Street/Charles Street/Stuart Street (NEMC Portal) Alternatives

Origin-Destination	Travel Time Savings (minutes per trip)	Total Weekday Transit Trips (trips per day)	Total Daily Savings (hours per day)
Chinatown to World Trade Center	8.8	800	117
Chinatown to Financial District/South Station	6.5	2100	227
Dudley Square to World Trade Center	9.9	1600	264
Dudley Square to Financial District/South Station	9.3	5000	778

Source: CTPS

Table 5.7-4 – Travel Time Savings Comparison: Silver Line Phase III Build vs. Baseline: Columbus Avenue Alternative

Origin-Destination	Travel Time Savings (minutes per trip)	Total Weekday Transit Trips (trips per day)	Total Daily Savings (hours per day)
Chinatown to World Trade Center	8.6	700	100
Chinatown to Financial District/South Station	6.2	1900	196
Dudley Square to World Trade Center	7.7	1200	154
Dudley Square to Financial District/South Station	6.3	3900	410

Source: CTPS

5.7.3 Potential Impacts to EJ Communities

The Silver Line Phase III project has been examined for the following categories of potential impacts on identified EJ communities:

- Takings and other community impacts;
- Traffic congestion due to reconfiguration of traffic patterns and operations of the Silver Line;
- Pedestrian impacts;
- Air quality, related to emissions from Silver Line vehicles as well as other motor vehicles; and
- Noise and vibration impacts.

For a more detailed discussion of each of these impact areas, refer to the appropriate section of this chapter. Construction period impacts are discussed in Chapter 6.

5.7.3.1 Property Takings and Other Community Impacts

As described in Section 5.2, there would be no residential land takings associated with any of the alternatives. The Charles Street Alternative would require the use of Elliot Norton Park, a neighborhood park, temporarily during construction. This park would be replaced following construction. (See Chapter 6 for a detailed discussion). Potential permanent and construction period impacts on the Boston Common, as described in Chapters 5 and 6 would be common to all alternatives.

Since the majority of the alignment is located underground, there is little potential for other impacts to community cohesion from isolation or division.

5.7.3.2 Traffic Impacts and Pedestrian Safety

As discussed in Section 5.3, the project would not result in deterioration of traffic conditions at intersections near the NEMC portal due to vehicle operations associated with Silver Line Phase III. Although there would be potential for some intersections near the Columbus Avenue portal to be affected by Silver Line operations, other intersections would experience improvements and all potential impacts would be fully mitigated in any case. During construction, portions of Essex Street and Boylston Street would be temporarily closed. Traffic detours were developed to maintain acceptable conditions at nearby intersections. Therefore, there would be no traffic impacts for EJ communities. See Sections 5.3 and 6.10 for a full discussion of traffic and parking impacts.

Implementation of a Build Alternative with either the NEMC portal or the Columbus Avenue portal would not result in any impacts to pedestrians. The project design would incorporate measures to improve pedestrian safety in the vicinity of the portal, such as pavement markings, bollards, signs and audible warning devices. Sidewalks in the vicinity of the portal would be improved. (See Section 5.4 for additional discussion.)

5.7.3.3 Air Quality

The emissions assessment presented in Section 5.5 shows that Silver Line Phase III will not result in significant negative air quality impacts compared to the No-Build Alternative. Phase III will utilize 60-foot articulated dual mode diesel-electric buses throughout the full build Silver Line tunnel and on surface routes in the Waterfront area, Back Bay, and Dudley Square. The only exception would be on the existing Phase I route between Dudley Square and Downtown Crossing, which would continue to utilize compressed natural gas (CNG) vehicles. This route would be retained once the Phase III tunnel is completed to meet transit demand between Dudley and downtown destinations. The dual mode vehicles would run on low-sulfur diesel fuel with state-of-the-art emissions control technology. Emissions of carbon monoxide (CO) and volatile organic compounds (VOC) would be significantly reduced compared to the No-Build Alternative, while emissions of oxides of nitrogen (NOx) and particulate matter (PM) would increase slightly (see Table 5.5-4). With both the current CNG technology and the planned diesel-electric technology, emissions of particulate matter, also known as soot, already have been reduced significantly compared to emissions from conventional diesel buses.

The microscale analysis is the component of the overall air quality impact analysis that focuses on the localized (rather than regional) changes in ambient air quality conditions that may occur with the implementation of the various Silver Line alternatives. The results of the microscale analysis of year 2013 one-hour conditions and for eight-hour conditions indicated that no violations of either the one-hour or eight-hour carbon monoxide (CO) NAAQS are predicted to occur at any of the analyzed locations. Based on this analysis, it can be concluded that no violations of the NAAQS for CO would occur throughout the area affected by Silver Line operations.

Furthermore, any changes in Silver Line corridor emissions would be far outweighed by reductions in total regional emissions resulting from reduced automobile traffic once the Phase III project is implemented. Reductions of HC and NOx emissions at a regional level would reduce the formation of ozone, a pollutant that can cause or exacerbate respiratory and cardiovascular ailments. As a result, the Silver Line Phase III project will not only help the Boston metropolitan area achieve attainment of national ambient air quality standards, but also will help improve air quality in inner city neighborhoods.

5.7.3.4 Noise and Vibration

Silver Line Phase III will operate rubber-tired vehicles, with the majority of the vehicles operating in the Core Tunnel Segment. The analysis indicates that based on FTA criteria, there would be no noise and vibration impacts during operation of Silver Line Phase III. (See Section 5.6 for additional discussion.) There will be noise and vibration impacts during construction of the preferred alternative; however, the impacts are not disproportionate to EJ communities (see Section 6.9 for additional discussion).

5.7.4 Conclusions

There are significant concentrations of populations meeting the Federal EJ criteria in the Silver Line Phase III corridor, and also in other neighborhoods served by the full build Silver Line project. These include low-income and minority populations in Chinatown, the South End and Roxbury/Dudley Square (see Section 4.3 for a fuller discussion). By providing quicker and more

convenient access to jobs in the downtown, Waterfront area, and at Logan Airport, the Silver Line Phase III project will provide a substantial benefit to these EJ population groups.

Federal policies require an analysis whether the project will have any disproportionately high and adverse human health and environmental effects on minority and low-income populations. As described above, the adverse impacts of the project on all parts of the Phase III corridor, including the EJ communities within it will be minimal. The air quality and traffic impacts of the Silver Line Phase III to communities in the corridor would be minimal. Corridor emissions of all pollutants from buses will be greatly reduced compared to year 2000 conditions and will show little change compared to current CNG buses. No local CO standards will be violated. Furthermore, regional emissions of ozone-forming pollutants will be reduced as a result of reductions in vehicle traffic. Because the Silver Line Phase III alternatives are mostly underground, takings and other community impacts also will be minimal. As described in detail in Section 5.2, there will be no residential takings, and the MBTA will work carefully with residents and businesses owned by women and minorities to minimize construction impacts. Further, as described in Chapter 4, the demographic composition of the communities served by the alternative alignments in terms of minority and populations and median income is very similar to the demographics of the City of Boston as a whole (see Table 4.3-1). Therefore, since all alternative alignments of Silver Line Phase III are located within the City, there would be no disproportionate adverse impacts caused by the project on minority and low-income populations.

Finally, as described in Chapter 8, the MBTA has undertaken extensive efforts in the planning and development of the Silver Line Phase III project to ensure that the needs and concerns of EJ communities in the corridor are responded to and addressed.

5.8 Geology and Groundwater

5.8.1 General

Groundwater management is a critical concern for Silver Line Phase III because the new tunnel would pass through both the upper and lower aquifers, discussed in Section 4.8.1, which may be susceptible to groundwater lowering. If the groundwater table in the upper aquifer drops below the tops of timber piles that support buildings, then the exposed portions of the piles may eventually rot. A drop in the groundwater table in the lower aquifer could cause the clay layer to consolidate and settle.

The Silver Line Phase III alignments that are of most concern with regard to groundwater are the alignments that are located closest to buildings supported by timber piles. These buildings are usually located in areas, such as Back Bay and Bay Village, where fill has been placed over organic soils to raise the ground surface. The only alignment that has a geologic profile showing fill placed over organics, and the only alignment with identified buildings supported on timber piles immediately along the alignment, is the Columbus Avenue alignment alternative. The remaining alignments alternatives (Tremont, Charles and Stuart Streets), all of which are located within the original Shawmut Peninsula (see Figure 4.8-1), are located farther away from buildings supported by timber piles.

Therefore, of the four proposed alignments, the Columbus Avenue alignment has the most potential for impacts associated with groundwater lowering. However, groundwater drawdown can occur hundreds of feet from the location of groundwater pumping, so all alignments would require consideration of special measures to limit groundwater drawdown during and after construction.

The decay and rot of timber piles due to lowered groundwater levels has been an ongoing and widely publicized problem in the City of Boston for many years. Significant structural and foundation damage has occurred in many historic buildings, particularly in those areas of Boston

formed by landfill such as the Back Bay, South End, and Bay Village neighborhoods of Boston. The result of this has been significant repair costs, lawsuits, and a heightened concern over new underground construction by residents in these areas of the city.

To address the issue of groundwater levels, the MBTA will install observation wells along the preferred alternative alignments, and at selected locations near the alignment in Bay Village and Back Bay. Final monitoring well locations will be determined in coordination with the Boston Groundwater Trust. The wells will provide a means to collect groundwater data before and during construction and to monitor groundwater levels on a regular basis after construction has been completed.

The following sections discuss design and construction measures that will be taken to avoid or minimize groundwater lowering associated with permanent construction, along with appropriate corrective actions to be taken where necessary. Chapter 6 discusses measures associated with potential temporary construction-period impacts.

5.8.2 Coordination with the Boston Groundwater Trust

The Boston Groundwater Trust (the Trust) was established in 1986 with the purpose of re-establishing and maintaining a system for monitoring groundwater levels in the areas of Boston that were created by the filling of former marshes and tidelands. These areas of the city include the Bay Village, Back Bay, Fenway, South End, lower Beacon Hill, and Chinatown. These parts of the city have been identified as areas that have experienced depleted groundwater levels due to leakage into underground pipelines and tunnels. Many of the historic buildings in these parts of the city were built on timber piles and could significantly suffer from depletion in groundwater levels.

The Trust installs and maintains observation wells and monitors groundwater levels, in the areas of the city discussed above. It maintains an inventory of this information in a computerized database that is available to the public through their website (www.bostongroundwater.org).

Observation and monitoring wells will be installed during design and construction of the Silver Line Phase III project. The MBTA will coordinate with the Trust when making decisions as to where to site the wells. Information regarding the wells, including installation logs, geographic locations, and groundwater levels will be provided to the Trust. In addition, the Trust will be given access to the wells so that they can measure groundwater levels independently. Upon completion of the project, the MBTA will turn over the wells to the Trust so that, if it chooses, the Trust can continue to use the wells for developing its own data. The MBTA will coordinate with the Boston Groundwater Trust during design and construction.

5.8.3 Design Criteria for Minimal Leakage

Ideally, underground structures would be watertight. In actuality, given current construction methods, some seepage is almost certain to occur in any tunnel. Therefore, the design intent will be to eliminate any free water leakage and to construct the tunnels with as little seepage as possible. Typical post-construction seepage rates through tunnel walls are approximately 1 gallon per minute per 1,000 linear feet of tunnel.[7] This rate will form the basis of design considerations for waterproofing systems discussed below.

[7] FHWA Highway and Rail Transit Inspection Manual. Reference: "Highway and Rail Transit Inspection Manual, Contract #DTFH61-01-C-0067, March 2003.

Although free water leakage is not acceptable in the tunnel construction, some measure of seepage is unavoidable due to the permeability of some materials required to be used. Three general waterproofing methods will be used to mitigate seepage:

- Waterproofing membrane around mined tunnels.
- Waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls.
- Special detailing at connection of mined tunnels to tunnels constructed inside slurry walls.

These waterproofing methods are consistent with the methods utilized for the Silver Line Phase II tunnels. Management of groundwater seepage after construction is further discussed in Section 5.9.2, while management of groundwater during construction is discussed in Chapter 6.

5.8.3.1 Waterproofing of Mined Tunnels

As the mined tunnels are advanced, a structural lining will be installed using sprayed-on concrete (shotcrete) or using gasketed steel or concrete lining plates. The structural lining will support the soil and maintain the structural integrity of the tunnel. Inside the structural lining, a continuous plastic waterproofing membrane would be installed, with sealed or welded seams. Inside the waterproofing membrane, another structural lining would be installed to provide additional structural support for the tunnel and to protect the waterproofing membrane.

This construction method would be used along the mined sections of the tunnels which include portions of the Core Tunnel Segment, the Charles Street alignment, and the Columbus Avenue alignment. This method was used by the MBTA for the Silver Line Phase II tunnel at Russia Wharf (Atlantic Avenue and Congress Street).

5.8.3.2 Waterproofing of Slurry Wall Sections

Waterproofing membranes would be installed below the floors and above the roofs of the tunnel sections constructed inside slurry walls. The slurry walls themselves would provide a nearly waterproof barrier for the tunnel. If seepage is identified at particular locations in the slurry walls, then holes can be drilled through the slurry walls and grout injected to block pores allowing the seepage.

This construction method would be used along the slurry wall portions of the tunnels. The slurry wall sections of the tunnel include: the Core Tunnel Segment near Atlantic Avenue and at the existing MBTA tunnel connections, the Tremont Street alignment, the Charles Street alignment from Elliot Norton Park to Washington Street, the Stuart Street Alignment along Tremont Street and the Columbus Avenue alignment west of Church Street.

The use of slurry walls as essentially waterproof basement walls is now considered standard practice for large buildings with basement parking garages. The buildings at 10 St. James Avenue and 131 Dartmouth Street in the Back Bay are two recent examples. The basements for these buildings are approximately 45 to 50 feet deep, similar to the depth of the proposed Silver Line Phase III tunnel.

5.8.3.3 Waterproofing at Connection of Mined Tunnels to Slurry Walls

The connection between mined tunnel sections and open trench or slurry wall tunnel sections would require special construction details to maintain a complete waterproofing barrier. These details would be similar to those developed for the recently completed Silver Line Phase II.

5.9 Natural Resources

This section discusses the potential for natural resource impacts associated with Phase III of the Silver Line. Potential impacts to natural resources would be limited because the Silver Line Phase III project is located in a densely developed urban area where there are few existing natural resources. As described in Section 4.9, there are no existing wetlands, floodplains, navigable waterways, or ecologically sensitive areas within the project corridor and no anticipated impacts to endangered species. Potential impacts to coastal zones and water quality are described below.

5.9.1 Coastal Zone

A portion of the Phase III alignment on Essex Street between South Station and the underground Central Artery (Interstate Route 93) is located within the Coastal Zone. The Silver Line Phase III project is consistent with Massachusetts Coastal Zone Management (CZM) Program Policies, and strongly supports the following:

- Public Access Management Principle #1 – Improve public access to coastal recreation facilities and alleviate auto traffic and parking problems through improvements to public transportation.

- Growth Management Principle #2 – Ensure that state and federally funded transportation and wastewater projects primarily serve existing developed areas, assigning highest priority to projects that meet the needs of urban and community development centers.

A CZM Consistency Determination was received from the Massachusetts Office of Coastal Zone Management in 1998 for the Transitway project, which incorporates that portion of the Silver Line Phase III alignment on Essex Street within the coastal zone.

5.9.2 Water Quality

Except for some parklands, the Silver Line Phase III project area is densely developed and consists of impervious surfaces such as building roofs, streets, sidewalks and parking lots. Construction of the Silver Line Phase III would result in no substantial change in the amount of impervious area. The project would not increase runoff or negatively affect surface water quality or flood storage. Stormwater runoff from the boat ramp section would be intercepted prior to the tunnel portal and routed through a deep-sump catch basin prior to discharge to the City of Boston's storm sewer system. Best Management Practices (BMPs) typical of street-maintenance activities such as street sweeping and cleaning of catch basins, as required by the Boston Water and Sewer Commission (BWSC), would be employed to minimize any potential water quality impacts associated with the runoff. In addition, a drainage system would be employed within the tunnel to capture any potential intermittent flows generated from such sources as tunnel structure seepage, vehicle drippings, tunnel washing operations, etc. Gravity flow would carry the water to a pumping station located at the low point of the Phase III tunnel. The pump station would include a deep sump prior to the wet well and submersible pumps. The sump would settle sand and grit with the excess water overflowing into the wet well. From the wet well the flows would be pumped to an oil/water separator prior to discharge to the City of Boston's storm sewer system. The deep sump and oil/water separator will minimize water quality impacts associated with intermittent discharges from the tunnel.

5.10 Cultural Resources

5.10.1 Regulatory Context

Analysis of potential impacts on cultural resources is required under NEPA, MEPA, Section 4(f) of the Department of Transportation Act of 1966 (Section 4(f))[8], Section 106 of the National Historic Preservation Act of 1966[9] and Massachusetts General Laws Chapter 9, Sections 26 and 27C[10]. Potential permanent impacts to cultural resources are summarized in this section. Construction period impacts are summarized in Section 6.4. A Section 4(f) Statement[11] for the preferred alternative will be circulated with the Supplemental Final EIS.

In 1994 a Record of Decision (ROD) was issued by the FTA that approved the 1993 FEIS/FEIR alignment. Subsequently a Memorandum of Agreement (MOA) was signed between the FTA, MBTA, the Advisory Council on Historic Preservation, Massachusetts Historical Commission (MHC), and the Boston Landmarks Commission (BLC). As described in Chapter 2, the 1993 alignment is substantially similar to the Core Tunnel Segment, except that the impacts to cultural resources, specifically to Boston Common and the Central Burying Ground, have been reduced or eliminated.

5.10.2 Core Tunnel Segment

The majority of the Silver Line Phase III project is located underground. Potential permanent effects to cultural resources would occur where the Silver Line Phase III project interfaces with the surface at the portal locations, at the Chinatown Station, and at the proposed new Boylston Station; and where cut and cover and tunnel mining would impact below ground strata identified as containing significant archaeological resources. Approximately 10 percent of the Core Tunnel Segment is sensitive for significant archaeological resources in project impact areas associated with the proposed Chinatown Station improvements and the new Boylston Station. The Core Tunnel Segment, including the proposed Chinatown and Boylston Stations, encompasses 60 historic resources, of which 49 will be affected and 11 will not be affected by the project. See Table 5.10-1 for a listing of the historic resources affected by the Core Tunnel Segment.

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[8] Section 4(f) of the Act directs the Secretary of Transportation to take special effort to preserve the natural beauty of the countryside and public parks and recreation lands, wildlife and waterfowl refuges, and historic sites; and to develop transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed. Regulations governing Section 4(f) implementation specify that there can be no taking of public parks, recreation land, or wildlife refuge, or impairment of any historic sites without a thorough investigation into whether or not there are any prudent and feasible alternatives exist and that all planning measures have been undertaken to minimize harm to the resource.

[9] The National Historic Preservation Act (NHPA), as amended, was enacted by Congress in 1966 to preserve and protect the nation's historic buildings, structures, neighborhoods, landscapes, and archaeological sites. The NHPA established the National Register of Historic Places (NRHP) and created the Advisory Council on Historic Preservation (ACHP). The NHPA fostered the system by which federal agencies identify and evaluate cultural resources. This information is used to plan projects that, where possible, preserve and protect significant cultural resources.

[10] MGL Chapter 9, Sections 26 and 27C, as amended, established the MHC, the Office of the State Archaeologist, the State Register, and the State Register review process. The chapter established a system whereby any person or agency conducting a field investigation must first obtain a permit from the State Archaeologist. The review process, modeled after Section 106, requires consultation among the responsible state agency(s), the MHC, and other interested parties to determine whether state funded or licensed projects would have any adverse effect on properties listed in the State Register of Historic Places. The project is being funded in part by the MBTA and thus falls within the purview of this statute.

[11] A Section 4(f) statement provides an administrative record documenting that the Federal agency (in this case FTA) has followed the regulatory requirements of Section 4(f) of the US Department of Transportation Act of 1966. It establishes a record of the basis for a determination that there is no feasible and prudent alternative to the use of a 4(f) resource and demonstrates that the Federal transportation agency has used all possible planning and measures to minimize harm.

Table 5.10-1: Core Tunnel Segment – Historic Resources Effects

Address	Historic Name/Function	Preliminary Determination of Effect [1]
620 Atlantic Avenue	South Station	No Effect
687-695 Atlantic Avenue	Hotel Essex; Plymouth Rock Building	Adverse Effect
66-86 Lincoln Street; or 70-80 Lincoln Street	Lincoln Building; Lincoln Plaza	Adverse Effect
125 Essex Street; or 104-122 Kingston Street	Achmuty Building; Dainty Dot Hosiery	No Effect
88 Kingston Street	[Commercial Block]	No Effect
105-107 Essex Street; or 129 Kingston Street, 2-12 Edinboro Street	Kingston Building	No Effect
80-82 Essex Street	[Commercial Block]	No Effect
76-78 Essex Street	[Manufacturing Block]	No Effect
81-83 Essex Street	Pelham Building	No Effect
73-79 Essex Street; or 208 Oxford Street	Joy Langdon Co.; Simons, Hatch & Whitten Co.	No Effect
62-72 Essex Street; or 102-116 Chauncy Street	[Manufacturing Block]	No Effect
2-8 Harrison Avenue; or 59-71 Essex Street/1-13 Oxford Street	Verizon N. E. Telephone Co.	No Effect
50 Essex Street	Wendell Phillips Office Building	Adverse Effect
41-45 Essex Street; or 1-5 Harrison Avenue	Kelley, Samuel D. Tenement Building	No Effect
588-622 Washington Street	n/a	Adverse Effect
25-31 Essex Street	Essex Hotel	Adverse Effect
15-17 Essex Street	[Commercial Block]	Adverse Effect
628-636 Washington Street; or 1-9 Essex Street	Liberty Tree Block & Union Hall	Adverse Effect
Essex Street	Liberty Tree Plaque/Monument	Adverse Effect
681-683 Washington Street	Hayden Building (Cathay Bank)	No Effect
Washington Street at Boylston Street at Essex	Essex Station	Adverse Effect
2-22 Boylston Street; or 651-657 Washington Street	Boylston Building (China Trade Center)	Adverse Effect
25-39 Boylston Street	Boston Edison Electric Illuminating Company	Adverse Effect
48-52 Boylston Street	Boston Young Men's Christian Union	Adverse Effect
62 Boylston Street	Hotel Touraine	Adverse Effect
183-186 Tremont Street; or 51-53 Boylston Street	Grand Lodge of Masons	Adverse Effect
Tremont Street	Tremont Street Subway Tunnel	Adverse Effect
180-182 Tremont Street	Boston Edison Electric	Adverse Effect
178-179 Tremont Street	Oliver Ditson Building	Adverse Effect
28-30 Avery Street	Boston Music Company	Adverse Effect
Tremont Street	Tremont Street Subway Station Head Houses	Adverse Effect
Boylston and Tremont Streets	Boylston Street Subway Station	Adverse Effect
N/A Boylston Street; or Beacon, Park, Tremont, and Charles Streets	Boston Common	Adverse Effect
74-94 Boylston Street; or 195-215 Tremont Street	Pelham Building; Little Building	Adverse Effect

Address	Historic Name/Function	Preliminary Determination of Effect [1]
96-106 Boylston Street	Colonial Building; Colonial Theater	Adverse Effect
114-116 Boylston Street	Walker Building; S.S. White Dental Co.	Adverse Effect
120-124 Boylston Street	Walker Building Addition	Adverse Effect
130-132 Boylston Street	Ginter Building - 1930s Tucker Building - 1940s	Adverse Effect
134-136 Boylston Street	[Unknown]	Adverse Effect
138-140 Boylston Street	S.S. White Dental Co.	Adverse Effect
158-160 Boylston Street	Vose Building	Adverse Effect
162 Boylston Street	Steinert, M. and Sons Musical Company Building	Adverse Effect
N/A Boylston Street	Central Burying Ground	Adverse Effect
2 Park Square (Charles Street); or 176A Boylston	Boylston Street Florist; L.J. Peretti Tobacconist	Adverse Effect
3 Park Square (Charles Street)	The Trolley Stop	Adverse Effect
4 Park Square (Charles Street)	Isóle	Adverse Effect
N/A Charles Street; or Arlington; Boylston; Park	Boston Public Garden	Adverse Effect
Tremont Street at Boylston Street	Tremont Street Tunnel South Extension	Adverse Effect
539 Washington Street	Savoy Theatre/B.F. Kieth Memorial	Adverse Effect
543-547 Washington Street; or 559 Washington Street	Amusement Center/Adams House Annex/Bijou Theatre	Adverse Effect
549-563 Washington Street; or 559 Washington Street	Paramount Theatre	Adverse Effect
89-99 Chauncy Street; or 7 Exeter Place; 21-29 Harrison Avenue	The Textile Building	Adverse Effect
105-111 Chauncy Street; or 11-19 Harrison Avenue	Frost Building	Adverse Effect
12 LaGrange Street	n/a	Adverse Effect
15-17 LaGrange Street	n/a	Adverse Effect
18 LaGrange Street	n/a	Adverse Effect
20-22 LaGrange Street	M-Centerfolds	Adverse Effect

Notes:

1 – The assignment of "Adverse Effect" represents a worse case scenario; that is, this approach assumes impacts that may turn out, upon further review or further design, to not be impacts at all. Firstly, the MBTA has assumed that all potentially eligible resources are in fact actually eligible. Further assessment may find that many of these resources are not eligible for cultural resource consideration under Section 106 or Section 4(f). Secondly, further design may result in many of these properties receiving a "No Adverse Effect" determination. As a result, the numbers of properties identified as "Adverse Effect" may in fact be substantially reduced as the project proceeds. This approach and assessment is done simply for the purpose of preliminary comparison of alignments in the SDEIS/EIR.

5.10.2.1 Chinatown Station

The proposed location of the emergency tunnel vent within the traffic island at the intersection of Essex Street and Harrison Avenue could impact significant archaeological resources. Potential impacts from surface structures could occur along this segment because of the structures associated with the proposed Chinatown Station (Figure 3.4-3), which is located within the Liberty Tree Historic District, a National Register (NR) Historic District. An emergency egress structure and vent structures are proposed near the Chinatown station. The location of the station access/emergency egress structure has not been finalized. Its final design and location would avoid and minimize impacts to historic resources to the extent possible. (See Table 5.10-2 for a summary of cultural resources.)

Table 5.10-2 – Chinatown Station

Proposed Structure	Historic Resources	Archaeological Resources
Station Emergency Egress structure to be located either in front of or within the basement of the China Trade Building	This structure would be located within the Liberty Tree Historic District. The China Trade Building is individually National Register (NR) listed, a local landmark (LL) and part of the Multiple Resource Area (MRA).	No significant resources identified
Emergency Tunnel Vent Shafts o In front of the China Trade Building within the sidewalk o Within a traffic island at the intersection of Essex Street/Harrison Avenue	These vent shafts would be located within the Liberty Tree Historic District.	No significant resources identified; Significant pre-contact Native American site and 18th-19th c. domestic site (4-6 ft to 10+ ft below surface)
Station Ventilation - Two fresh air vents are proposed within the sidewalk along Boylston and Essex Streets.	These vents would be located within the Liberty Tree Historic District.	No significant resources identified

5.10.2.2 Boylston Station

The proposed locations of the emergency egress adjacent to the Deer Park Maintenance Area on Boston Common and the emergency tunnel vent at the southeast corner of Charles and Boylston Streets could impact significant archaeological resources. The turnaround loop under the intersection of Charles and Boylston Streets would be entirely below ground, so there are no direct impacts to historic aboveground resources, but the construction of the underground tunnel loop including a mining/ventilation shaft could impact deeply buried significant Native American fishweir site(s)

As with the 1993 FEIS/FEIR alignment, Boylston Station would require a number of structures, some stand-alone and some accessory structures, that could affect historic or archaeological resources. Table 5.10-3 describes the structures that have been preliminarily identified as necessary to provide access and comply with life safety requirements (including emergency egress and ventilation) and their potential impacts on cultural resources. For a more detailed description of measures to minimize and mitigate the impacts of the emergency egress and ventilation structures, see Section 5.12.

Table 5.10-3 – Boylston Station

Proposed Structure	Historic Resources	Archaeological Resources
Silver Line station entry – An escalator, stairs and an ADA elevator are proposed inside the corner of the Little Building, 80 Boylston Street.	The Little Building is a contributing building within the Piano Row Historic District (listed on the National Register (NR)).	No significant resources identified
Emergency egress – in the Walker Building (Shawmut Bank), 120-124 Boylston Street	The Walker Building is a contributing building to the Piano Row Historic District.	No significant resources identified
Emergency egress - adjacent to the Deer Park Maintenance Area on Boston Common	The Boston Common is on the NR and is an NHL.	Post-contact period interments associated with the Central Burying Ground, 4-6 ft below surface
Green Line outbound elevator – A structure is proposed north of the existing Green Line outbound headhouse (Boylston Station) on Boston Common	The Boston Common is on the NR and is an NHL.	No significant resources identified
Green Line outbound/ inbound second emergency egress – Both emergency egress structures are within the footprints of the former Green Line headhouses, which were demolished circa 1960, on Boston Common	The Boston Common is on the NR and is an NHL.	No significant resources identified
Emergency Tunnel Vents • Within the existing Green Line shaft in the Deer Park Maintenance Facility yard, which is located within Boston Common. • At the southeast corner of Charles and Boylston Streets.	• None • This area is within the Piano Row Historic District.	• No significant resources identified • Significant pre-contact/ contact period Native American fishweir site(s) (5-10 ft to 10+ ft below surface)
Station Ventilation - Two fresh air vents are proposed in the sidewalk, on the south side of Boylston Street.	This area is within the Piano Row Historic District.	No significant resources identified

5.10.3 Tremont Street Alternative

The Tremont Street Alternative encompasses a total of 18 historic resources, of which 12 will be affected and 6 will not be affected by the project. The Tremont Street Alternative would require the demolition of the abandoned southern extension of the Tremont Street Subway Tunnel, which is considered eligible for listing on the National Register as part of the original Tremont Street Subway system. The Tremont Street Subway Tunnel South Extension is identified as the first subway tunnel with three tracks in parallel alignment at separate levels (two above and one below) that join in a complex junction into a single tunnel. In the late 1960s, the southern portion of the tunnel at the incline where the surface streetcar lines entered the tunnel was filled in for the construction of the Church of All Nations. See Table 5.10-4 for a listing of historic resources affected by the Tremont Street Alternative.

Approximately 20 percent of the Tremont Street Alternative is sensitive for significant archaeological resources in project impact areas associated with the proposed portal at NEMC. This area contains significant 19th century domestic structures and associated yard areas from 2-5 ft to 10 ft below surface.

Table 5.10-4: Tremont Street Alternative – Historic Resources Effects

Address	Historic Name/Function	Preliminary Determination of Effect [1]
Tremont Street at Boylston Street	Tremont Street Tunnel South Extension	Adverse Effect
216-218 Tremont Street; or 115 LaGrange Street	Union Savings Bank Building	Adverse Effect
Tremont Street	Saxon Theater; Emerson Majestic Theater	Adverse Effect
219-221 Tremont Street	--	Adverse Effect
224 Tremont Street	--	Adverse Effect
226 Tremont Street	--	Adverse Effect
228 Tremont Street	--	No Effect
232 Tremont Street	--	No Effect
236 Tremont Street	--	Adverse Effect
154 Stuart Street	New England School of Law	No Effect
94-102 Warrenton Street	Stevens-Locke Co. Plumbing Supply Building	No Effect
90 Warrenton Street	Hotel Hampton	No Effect
244-248 Tremont Street	Wilbur Theater	Adverse Effect
252-272 Tremont Street	Wang Theater and NEMC Outpatient Building	Adverse Effect
253-261 Tremont Street	Alsie's Stage Bar	No Effect
263-265 Tremont Street	Schubert Theater	Adverse Effect
271-279 Tremont Street	Bradford Hotel; B.P.O.E. #10	Adverse Effect
300 Tremont Street; or 821 Washington Street	Don Bosco School; Double Tree Hotel	Adverse Effect
Tremont Street at Boylston Street	Tremont Street Tunnel South Extension	Adverse Effect
216-218 Tremont Street; or 115 LaGrange Street	Union Savings Bank Building	Adverse Effect
Tremont Street	Saxon Theater; Emerson Majestic Theater	Adverse Effect
219-221 Tremont Street	--	Adverse Effect
224 Tremont Street	--	Adverse Effect
226 Tremont Street	--	Adverse Effect
228 Tremont Street	--	No Effect
232 Tremont Street	--	No Effect
236 Tremont Street	--	Adverse Effect
154 Stuart Street	New England School of Law	No Effect
94-102 Warrenton Street	Stevens-Locke Co. Plumbing Supply Building	No Effect
90 Warrenton Street	Hotel Hampton	No Effect
244-248 Tremont Street	Wilbur Theater	Adverse Effect
252-272 Tremont Street	Wang Theater and NEMC Outpatient Building	Adverse Effect
253-261 Tremont Street	Alsie's Stage Bar	No Effect
263-265 Tremont Street	Schubert Theater	Adverse Effect
271-279 Tremont Street	Bradford Hotel; B.P.O.E. #10	Adverse Effect
300 Tremont Street; or 821 Washington Street	Don Bosco School; Double Tree Hotel	Adverse Effect

Notes:

1 – The assignment of "Adverse Effect" represents a worse case scenario; that is, this approach assumes impacts that may turn out, upon further review or further design, to not be impacts at all. Firstly, the MBTA has assumed that all potentially eligible resources are in fact actually eligible. Further assessment may find that many of these resources are not eligible for cultural resource consideration under Section 106 or Section 4(f). Secondly, further design may result in many of these properties receiving a "No Adverse Effect" determination. As a result, the numbers of properties identified as "Adverse Effect" may in fact be substantially reduced as the project proceeds. This approach and assessment is done simply for the purpose of preliminary comparison of alignments in the SDEIS/EIR.

5.10.4 Charles Street Alternative

The Charles Street Alternative encompasses a total of 19 historic resources, of which 9 will be affected and 10 will not be affected by the project. Construction of the Charles Street alignment where it crosses Tremont Street would require the demolition of approximately 80 linear feet of the abandoned Tremont Street Subway Tunnel South Extension. See Table 5.10-5 for a listing of historic resources affected by the Charles Street Alternative.

Approximately 95 percent of the Charles Street Alternative is sensitive for significant archaeological resources in project impact areas associated with the mining for the tunnel in the Charles Street ROW, the cut and cover construction area through Elliot Norton Park, and the proposed portal at NEMC. These areas contain significant pre-contact Native American fishweir and camp site(s) and 18th to 19th century domestic/commercial structures and former yard areas from 2-5 ft to 10 ft+ below surface.

Table 5.10-5: Charles Street Alternative – Historic Resources Effects

Address	Historic Name/Function	Preliminary Determination of Effect [1]
Tremont Street at Boylston Street	Tremont Street Tunnel South Extension	Adverse Effect
154 Stuart Street	New England School of Law	No Effect
94-102 Warrenton Street	Stevens-Locke Co. Plumbing Supply Building	No Effect
90 Warrenton Street	Hotel Hampton	No Effect
253-261 Tremont Street	Alsie's Stage Bar	No Effect
263-265 Tremont Street	Schubert Theater	No Effect
271-279 Tremont Street	Bradford Hotel; B.P.O.E. #10	Adverse Effect
300 Tremont Street; or 821 Washington Street	Don Bosco School; Double Tree Hotel	Adverse Effect
60-72 Eliot St; or 11-29 Broadway Stt; 4-20 Columbus Ave; 201-401 Stuart St	Motor Mart Garage	No Effect
58 Charles Street South	N/A	Adverse Effect
60 Charles Street South	N/A	Adverse Effect
70-74 Charles Street South	Boston Edison Substation	No Effect
76-82 Charles Street South	Hotel Sumner	Adverse Effect
76-78 Warrenton Street	5th Universalist Church; Charles Playhouse	No Effect
95-97 Broadway Street	[Unknown]	No Effect
99 Broadway Street	[Dwelling]	No Effect
115 Broadway Street	Boston Chinese Church of Saving Grace	Adverse Effect
1+3 Lyndeboro Place	[Dwelling]	Adverse Effect
2+4 Lyndeboro Place	[Dwelling]	Adverse Effect

Notes:

1 – The assignment of "Adverse Effect" represents a worse case scenario; that is, this approach assumes impacts that may turn out, upon further review or further design, to not be impacts at all. Firstly, the MBTA has assumed that all potentially eligible resources are in fact actually eligible. Further assessment may find that many of these resources are not eligible for cultural resource consideration under Section 106 or Section 4(f). Secondly, further design may result in many of these properties receiving a "No Adverse Effect" determination. As a result, the numbers of properties identified as "Adverse Effect" may in fact be substantially reduced as the project proceeds. This approach and assessment is done simply for the purpose of preliminary comparison of alignments in the SDEIS/EIR.

5.10.5 Stuart Street Alternative

The Stuart Street Alternative encompasses a total of 13 historic resources, of which 7 will be affected and 6 will not be affected by the project. Construction of the Stuart Street alignment across and under Tremont Street would require the demolition of approximately 625 linear feet of the abandoned Tremont Street Subway Tunnel South Extension. See Table 5.10-6 for a listing of historic resources affected by the Stuart Street Alternative.

Approximately 50 percent of the Stuart Street Alternative is sensitive for significant archaeological resources in project impact areas associated with the mining for the tunnel including ventilation shafts in the Charles Street ROW and the proposed portal at NEMC. These areas contain significant pre-contact Native American fishweir site(s) and 19th century domestic/commercial structures and associated yard areas from 2-5 ft to 10+ ft below surface.

Table 5.10-6: Stuart Street Alternative – Historic Resources Effects

Address	Historic Name/Function	Preliminary Determination of Effect [1]
Tremont Street at Boylston Street	Tremont Street Tunnel South Extension	Adverse Effect
232 Tremont Street		No Effect
236 Tremont Street		No Effect
154 Stuart Street	New England School of Law	Adverse Effect
94-102 Warrenton Street	Stevens-Locke Co. Plumbing Supply Building	No Effect
90 Warrenton Street	Hotel Hampton	No Effect
244-248 Tremont Street	Wilbur Theater	Adverse Effect
252-272 Tremont Street	Wang Theater and NEMC Outpatient Building	Adverse Effect
253-261 Tremont Street	Alsie's Stage Bar	No Effect
263-265 Tremont Street	Schubert Theater	Adverse Effect
271-279 Tremont Street	Bradford Hotel; B.P.O.E. #10	Adverse Effect
300 Tremont Street; or 821 Washington Street	Don Bosco School; Double Tree Hotel	Adverse Effect
60-72 Eliot Street; or 11-29 Broadway St.; 4-20 Columbus Ave.e; 201-401 Stuart St.	Motor Mart Garage	No Effect

Notes:

1 – The assignment of "Adverse Effect" represents a worse case scenario; that is, this approach assumes impacts that may turn out, upon further review or further design, to not be impacts at all. Firstly, the MBTA has assumed that all potentially eligible resources are in fact actually eligible. Further assessment may find that many of these resources are not eligible for cultural resource consideration under Section 106 or Section 4(f). Secondly, further design may result in many of these properties receiving a "No Adverse Effect" determination. As a result, the numbers of properties identified as "Adverse Effect" may in fact be substantially reduced as the project proceeds. This approach and assessment is done simply for the purpose of preliminary comparison of alignments in the SDEIS/EIR.

5.10.6 Columbus Avenue Alternative

The Columbus Avenue Alternative encompasses a total of 27 historic resources, of which 20 will be affected and 7 will not be affected by the project. See Table 5.10-7 for a listing of historic resources affected by the Columbus Avenue Alternative. Access to four individual buildings could be affected by the Columbus Avenue portal:

- 135 Columbus Avenue has Flash's Cocktails on the ground floor, with offices on the upper levels. Although there is no pedestrian access at this location, access for rubbish removal or delivery services would be impeded.

- 139 Columbus Avenue (Baron Baptiste Yoga). Although access at this location is primarily pedestrian, access for service delivery and rubbish removal could be affected.

- Benjamin Franklin Smith Printers at 147 Columbus Avenue would lose access to their loading dock.

- The Salvation Army Headquarters, at 155 Columbus Avenue would lose access to their parking lot and below-ground loading dock off of Columbus Avenue.

All of the Columbus Avenue Alternative is sensitive for significant archaeological resources in project impact areas associated with the mining for the tunnel in the Columbus Avenue ROW and the cut and cover construction area for the portal. The sensitive archaeological strata containing deeply buried pre-contact Native American fishweir site(s) are situated between 4-5 ft to 42+ ft below ground surface.

Table 5.10-7: Columbus Avenue Alternative – Historic Resources Effects

Address	Historic Name/Function	Preliminary Determination of Effect [1]
60-72 Eliot St.; or 11-29 Broadway St.; 4-20 Columbus Ave.; 201-401 Stuart St.	Motor Mart Garage	Adverse Effect
N/A Eliot; or Providence; Columbus	Emancipation Group	No Effect
54-78 Arlington; or 9-61 Columbus; 10-56 Providence	Park Plaza Hotel & Towers/Statler Office Building & Hotel	Adverse Effect
244-250 Boylston; or 23-29 Providence	Garden Building	No Effect
212 Stuart Street	Jae's	Adverse Effect
16 Shawmut Street	Attached Row Houses	No Effect
18 Shawmut Street	Attached Row Houses	No Effect
22 Shawmut Street	Attached Row Houses	No Effect
28 Shawmut Street	Attached Row Houses	No Effect
69 Church	Storefront	No Effect
100 Arlington; or 250 Stuart	Consolidated Gas Company Building	Adverse Effect
75-81 Arlington; 301-305 Stuart; 2-6 St. James	Paine Furniture Building	Adverse Effect
130 Columbus Avenue; or 97-105 Arlington	1st Corps of Cadets Armory	Adverse Effect
129-133 Columbus Avenue; or 304-306 Stuart	[No name]	Adverse Effect
135-137 Columbus Avenue; or 310-312 Stuart	[No name]	Adverse Effect
139-145 Columbus Avenue; or 314-316 Stuart	[No name]	Adverse Effect
147-153 Columbus Avenue; or 320-322 Stuart	[No name]	Adverse Effect
162-172 Columbus Avenue	Carter's Ink Factory	Adverse Effect
330 Stuart Street; or 155 Berkley	Salada Tea Building/Berkley Place	Adverse Effect
200 Columbus Avenue	Ladder 17 Engine 7 District 4 Fire Station	Adverse Effect

Address	Historic Name/Function	Preliminary Determination of Effect [1]
187 Columbus Avenue; or Berkeley Street	Salvation Army State Headquarters	Adverse Effect
34 Isabella Street	--	Adverse Effect
23 Cortes Street	--	Adverse Effect
25 Cortes Street; or 40 Isabella Street	Hotel Clifford	Adverse Effect
25 Columbus Avenue; or Berkley Street	Rowhouse	Adverse Effect
195-215 Columbus Avenue; or 140-144 Berkeley Street	Pledge of Allegiance Building/Youth's Companion Building	Adverse Effect
Columbus Avenue; or Church Street; Stuart Street	Statler Park and Fountain	Adverse Effect

Notes:

1 – The assignment of "Adverse Effect" represents a worse case scenario; that is, this approach assumes impacts that may turn out, upon further review or further design, to not be impacts at all. Firstly, the MBTA has assumed that all potentially eligible resources are in fact actually eligible. Further assessment may find that many of these resources are not eligible for cultural resource consideration under Section 106 or Section 4(f). Secondly, further design may result in many of these properties receiving a "No Adverse Effect" determination. As a result, the numbers of properties identified as "Adverse Effect" may in fact be substantially reduced as the project proceeds. This approach and assessment is done simply for the purpose of preliminary comparison of alignments in the SDEIS/EIR.

5.10.7 Conclusion and Mitigation Options

A Section 106 Consultation Programmatic Agreement for cultural resources will be executed for the Silver Line Phase III preferred alternative, for inclusion in the project's Supplemental Final EIS/EIR. Consulting parties for the development of the Programmatic Agreement (PA) will include the Federal Transit Administration, the Massachusetts Bay Transportation Authority, the Massachusetts State Historic Preservation Officer (Massachusetts Historical Commission), the Wampanoag Tribal Historic Preservation Officer (THPO), the Boston Landmarks Commission and other appropriate city agencies, and other interested parties that may be identified. A Section 4(f) statement will be circulated for public review with the Supplemental Final EIS.

For aboveground resources, various measures may be employed to avoid, minimize and/or mitigate any permanent adverse effects to National Register listed or eligible historic resources. Where demolition (i.e., Tremont Street Subway Tunnel) or permanent changes will occur, the current appearance and historical significance of historic resources will be archivally documented to the standards of the Massachusetts Historical Commission and the National Park Service. Long-term visual impacts will be limited to locations of permanent surface elements and will be mitigated by location and design that is sensitive to the adjacent historic resources and meets the Secretary of the Interior's Standards. The agency consultation process may identify additional mitigation actions. Construction impacts and mitigation are discussed in Section 6.4. In addition, survey and National Register evaluation of the properties that appear to be more than 50 years old and that have not been surveyed, as well as National Register evaluation of the previously surveyed historic resources, would be undertaken for the preferred alternative alignment corridor.

For archaeological resources, mitigation options for significant archaeological sites consist of avoidance or an archaeological data recovery program. Should avoidance of the identified sensitive areas not be deemed feasible, archaeological data recovery will be conducted in advance of project construction to recover all the significant data from the site(s). Should avoidance of the human burials on Boston Common not be possible, then these burials will need to be relocated inside the walls of the Central Burying Ground. Prior to the development of site-specific data recovery plans, additional archival and geotechnical research to determine the precise horizontal location and vertical depth of archaeologically sensitive strata within the Silver

Line Phase III preferred alternative alignment would be conducted. This research would include a review of all soil borings conducted for the project, current underground utility locations, and street widening plans and profiles. The additional research and subsurface testing program(s) would need to be conducted under an archaeological permit issued by the State Archaeologist/Deputy State Historic Preservation Officer, in accordance with the project's PA stipulations for the protection of archaeological resources, including consultation and review by the Wampanoag THPO.

Once a preferred alternative is selected, an intensive (locational) survey would be coordinated with the State Historic Preservation Officer (SHPO), FTA, and MBTA, and undertaken in accordance with the standards of the MHC, the State Archaeologist's permit regulations, the Secretary of the Interior's Standards and Guidelines for Identification, and the National Park Service guidelines for assessing eligibility for listing in the National Register. If resources identified are determined eligible for listing in the National Register, the SHPO would be consulted to determine where any project effects can be prudently or feasibly avoided, minimized, or mitigated. The findings of the above ground and archeological evaluations of the Preferred Alternative will be presented in the Supplemental Final EIS. This Section 4(f) statement will be circulated with the Supplemental Final EIS.

5.11 Parklands

5.11.1 Regulatory Context

Parkland resources within the project study area are also protected by Section 4(f) of the Department of Transportation Act of 1966 and Article 97 of the Constitution of the Commonwealth of Massachusetts, and impacts to the Boston Common and Public Garden are regulated under Section 6(f) of the Land and Water Conservation Fund Act of 1965.[12] This section describes potential parkland impacts resulting from the Silver Line Phase III project. The Section 4(f) Statement will be circulated with the Supplemental Final EIS.

In 1994 a Record of Decision (ROD) was issued by FTA that determined that the 1993 FEIS/FEIR alignment satisfied the requirements of NEPA and Section 4(f). The 1993 alignment is substantially similar to the Core Tunnel Segment, except that some impacts, especially impacts to the Boston Common, have been reduced. Once the preferred alternative for Silver Line Phase III is identified any change in use of parkland as a result of the project would require this same determination and, under Article 97, would also require a two-thirds vote of the Massachusetts Legislature. If there would be impacts to the Boston Common or Public Garden, the conversion requirements of Section 6(f) would also be met.

As described in Section 5.10.7 and Section 5.12, there will be close coordination of project design of these structures with the MHC, BLC, and Boston Parks and Recreation Commission to minimize and mitigate impacts on parklands, consistent with their historic character.

[12] The act established the Land and Water Conservation Fund, a matching assistance program that provides grants which pay half the acquisition and development cost of outdoor recreation sites and facilities. Section 6(f) of the act prohibits the conversion of property acquired or developed with these grants to a non-recreational purpose without the approval of the Department of Interior's (DOI's) National Park Service. The DOI must ensure that replacement lands of equal value, location and usefulness are provided as a condition of such conversions. Consequently, where conversions of Section 6(f) lands are proposed, replacement lands are required.

5.11.2 Core Tunnel Segment

The Core Tunnel Segment would be located within Boylston Street which is the southern boundary of the Boston Common. As described in Section 5.12, construction of emergency egress and vent structures associated with the Silver Line Boylston Station which are required for public safety would result in unavoidable impacts to Boston Common. These structures include:

- Emergency egress - adjacent to the Deer Park Maintenance Facility on Boston Common.
- Green Line outbound elevator – A structure is proposed north of the existing Green Line outbound headhouse (Boylston Station) on Boston Common.
- Green Line outbound/inbound second emergency egress – Both emergency egress structures would be located within the footprints of the former Green Line headhouses on Boston Common, which were demolished circa 1960.
- Emergency tunnel ventilation for the Silver Line Boylston Station would utilize the existing tunnel vent structure within the Deer Park Maintenance Facility and therefore would not result in any parkland impacts.

5.11.3 Tremont Street Alternative

There are no anticipated effects on parklands for the Tremont Street alignment.

5.11.4 Charles Street Alternative

There would be no permanent impacts to parklands for the Charles Street alignment. The Charles Street Alternative alignment would be located primarily within the right-of-way of Charles Street South and in an easement under Elliot Norton Park. There would be no impact to the adjacent Bay Village Neighborhood Park from the Silver Line Phase III project as this section of the alignment would be mined.

As described in Chapter 6, there would be construction period impacts to Elliot Norton Park. The southern segment of the Charles Street Alternative tunnel that traverses Elliot Norton Park would be constructed with a cut-and-cover construction method, resulting in temporary construction phase impacts to the park. The park would be completely restored after this tunnel section was completed, and, therefore, there would be no permanent impacts to Elliot Norton Park associated with the Silver Line Phase III project if this alternative were implemented. Chapter 6.0 contains a more detailed discussion of construction phase impacts and mitigation measures.

5.11.5 Stuart Street Alternative

There are no anticipated effects on parklands for the Stuart Street alignment.

5.11.6 Columbus Avenue Alternative

There would be no permanent impacts to parklands for the Columbus Avenue alignment.

5.12 Visual and Aesthetics

This section describes visual impacts related to the four Phase III alignment alternatives. The FTA defines visual impacts as those projects having visual effects on their surrounding environment. The following types of urban mass transit projects generally require an assessment of visual effects on the environment: new fixed guideway systems and extensions; projects involving construction that may affect historic sites; projects requiring extensive remodeling of

buildings or their surrounding area that may not be compatible with the character of the area; and most elevated guideway projects. Silver Line Phase III is a new guideway extension project that occurs under or adjacent to an historic area in a dense urban environment. The project creates approximately one mile of new tunnel and reuses existing station entrances and other surface elements where possible, thus avoiding or minimizing visual and other impacts.

The proposed Core Tunnel Segment of the Silver Line Phase III project commences underground at South Station and proceeds west for approximately one-half mile in tunnel, serving two stations, and terminating in a turnaround loop. (See Section 3.4.1 for a description of the Core Tunnel Segment.) Emergency egress structures, ventilation structures, and station entrances are the only elements of the Core Tunnel Segment that are visible from ground level and will have a visual impact.

Beyond the end of the Core Tunnel Segment, four alternative alignments are under consideration. There are no permanent visual impacts at surface level resulting from the below ground portion of these alignments. For the three alignment alternatives that portal at NEMC, the visual impacts are low to moderate and center on the portal and associated ramps, infrastructure, and surface station near Washington Street.

The fourth alignment alternative under consideration is the Columbus Avenue Alignment and portal. As for the other alternatives, there are no permanent visual impacts at surface level resulting from the below ground portion of this alignment. The visual impacts of this alignment alternative are low to moderate, and center on the portal and associated ramps, infrastructure, and surface stop along Columbus Avenue.

The discussion of permanent visual impacts covers the following aspects of the system:

- Emergency egress structures
- Ventilation structures
- Chinatown and Boylston Stations
- NEMC portal
- Columbus Avenue portal

Visual impact analysis covers the proposed alternatives and also analyzes the visual sensitivity of the area to the proposed alternatives.

5.12.1 Emergency Egress Structures

5.12.1.1 Chinatown Station

A new emergency egress structure is proposed to be located either within the China Trade Building or within the plaza in front of the China Trade Building. The final size and location of the structure will be determined by fire/life safety criteria applied to the design. If the emergency egress is incorporated into an existing building, passengers would exit into a basement or ground floor lobby level of a building that guarantees public access during operating hours. The resulting visual impact is low to none as the emergency egress is designed and constructed to match the existing architectural character of the building. Visual impacts of free-standing structures, however, are potentially high and careful attention to architecture design, detailing, materials, security and placement relative to adjacent views and structures is required to minimize impacts.

5.12.1.2 Boylston Station

This station will require two emergency egress structures described below:

Emergency egress structure at 124 Boylston Street

An emergency egress serving Boylston Street Station will be incorporated into the structure of 124 Boylston Street, currently occupied by Remington's Restaurant.

Emergency egress structures on Boston Common

To satisfy life safety requirements, an emergency egress structure from the Silver Line Boylston station is proposed to be constructed adjacent to the Deer Park maintenance facility. It would have a stairway connecting the tunnel area to the surface through an emergency exit door. The stairwell would be surrounded by a low knee wall, with design and materials to complement the existing stone wall around the Deer Park Maintenance Facility. Three new structures associated with the Green Line, to comply with Americans with Disabilities Act (ADA) regulations that are triggered by new work associated with the below-grade portions of the Green Line station, are also proposed on Boston Common. These structures include an elevator entrance/egress, a Green Line outbound second emergency egress, and a Green Line inbound second emergency egress[13].

Visual impacts of free-standing structures such as the elevator entrance/egress potentially are high, and careful attention to architectural design, detailing, materials, security, and placement relative to adjacent views and structures is required to minimize impacts. The historic Boston Common is a visually sensitive area. Pedestrians and drivers on Boylston Street enjoy year-round views of parklands, a historic cemetery, and period architecture of the Green Line head houses. People viewing Boylston Street and the Boston Common from buildings on the south side of Boylston Street enjoy some of the best panoramas in Boston: Tremont Street to the east, parklands rising to the south slope of Beacon Hill, the Bulfinch-designed State House and 19th century brick buildings of Beacon Street, and the Boston Public Garden and Back Bay to the west. The potential visual impact of a structure in this area would be high and would be extensively mitigated through the design and the use of high quality materials. The design would be reviewed by the MHC and BLC in accordance with the MOA (see discussion of cultural resource impacts in Section 5.10).

5.12.2 Ventilation Structures

Ventilation structures are required to aid in the evacuation of smoke from the tunnel or the supply of fresh air to the tunnel in the event of fire (see Section 5.13). Ventilation structures consist of a reversible fan located below ground in a utility room connected to plenums which carry air to or from the surface. At the surface the air shaft terminates in an accessible sidewalk grate occupying approximately 100 to 200 square feet (with dimensions of 10x10 feet or 20x10 feet) which visually appears to be part of the sidewalk. The visual impact is low to none.

Four ventilation grates are required at surface level for the proposed project. Two ventilation structures would be required for the Chinatown Station. Although the exact location would be determined during final design, one structure would likely be located at the intersection of Essex

[13] The graphic identifies locations of emergency egress-only stairs on the Boston Common. These stairs as proposed would be exposed to the weather, with only a knee-wall around the perimeter. However, the MBTA, in conjunction with the Boston Landmarks Commission, will seek approval from the Massachusetts Department of Public Safety (DPS) to allow the use of a pop-up hatch instead of the open stairwell to reduce visual impacts to Boston Common. This is a covered opening flush with the ground, with a hatch that would be opened from within in case of emergency. The MBTA received approval to us e pop-up hatches for the Green Line accessibility project at Copley Station adjacent to the Boston Public Library which is also within a significant historic resource area. For the purpose of this environmental review, the MBTA is showing the stairways with knee walls, in the event that DPS does not approve the pop-up system on Boston Common for emergency egress for Boylston Station, as it represents a worst case with regard to visual impacts on Boston Common.

Street and Harrison Avenue and another at the south side of Essex Street in an area of widened sidewalk approximately 100 feet west of the intersection with Washington Street.

For the Boylston Station, two ventilation grates are proposed within the right-of-way on the south side of Boylston Street, across from the Deer Park maintenance facility. One ventilation grate is proposed at the corner of Boylston Street and Charles Street.

5.12.3 Stations

Two new underground stations with 220-foot long platforms are planned at Chinatown and Boylston Stations. In both cases the entire station is below grade and no visual impact is created. Station entrances are, however, at grade and are discussed below.

5.12.3.1 Chinatown Station

The visual impacts of the proposed emergency egress structure are described in Section 5.12.1.1.

5.12.3.2 Boylston Street Station

Access to Boylston Station would be through a permanent easement of the ground floor commercial area of the Little Building at the corner of Boylston and Tremont Streets. Passengers would enter the building and utilize stairs, an escalator or elevator to access the fare lobby and platforms. Signage graphics would be installed on the building façade at street level to indicate access to the Silver Line consistent with applicable historic preservation standards. Visual impact resulting from this entrance is low to none.

5.12.4 NEMC Portal

The 330-foot long boat section that comprises the NEMC portal and ramp to surface provides the operational connections between Phases I and III of the Silver Line. Washington Street in this area has heavy pedestrian and automobile traffic due to the high density of residential and institutional buildings. The visual quality of the area to be occupied by the proposed portal is low as it is currently a surface parking lot. Several adjacent buildings, however, have views toward the parking area. The surrounding buildings occupy a dense institutional zone of the city and several architectural periods are represented from nineteenth century to modern. Bordering the north side of the portal boat section is a nine story parking garage and Orange Line headhouse. Immediately adjacent to the portal on the south side is a seven story hotel. Directly east of the portal across Washington Street is the campus of the New England Medical Center, a teaching hospital of Tufts University. The portal area is visually sensitive given the density of the neighborhood, the number of pedestrians (employees of institutions, visitors/patients, residents of nearby apartment towers), hotel guests, and automobile and transit commuters.

5.12.4.1 Portal

The portal is the opening through which transit vehicles enter and exit the tunnel. It is located below grade adjacent to the east sidewalk of Tremont Street and is not visible from adjacent streets. The visual impact is low to none.

5.12.4.2 Boat Section

The boat section is an inclined two-lane roadway transitioning from the tunnel to surface elevation over a distance of approximately 330 feet. There are concrete walls approximately 18 inches in thickness from the roadbed to the surface. These walls act to retain earth and the entire structure

resembles an open-roofed ramp descending from grade to a tunnel opening. Since most or all of the boat section is below grade the resulting visual impact is low to none.

5.12.4.3 Catenary

Electric wires, commonly known as catenary or trolley wires, power the vehicle motors when operating in the tunnel. The trolley wires are suspended from the tunnel roof. They continue the length of the boat section to the intersection with Washington Street where the vehicles change over to diesel-powered GenSet on the southbound route or from GenSet to electric for the northbound (in tunnel) route. The wires, two for each lane, are suspended from attachments along the side of the boat section. As the ramps ascend toward grade, the catenary is suspended from poles. The MBTA would work with BTD to have these poles be consistent with their street lighting standards. The visual impact of the terminus of the catenary system is moderate to high depending on the angle of view. When viewed from the front, a large sign banner with attractive graphics between the two terminating poles, along with ornamental lighting and landscaping, would be designed to mitigate the visual impact. When viewed from behind, several insulators for the trolley wires will be visible. Careful attention to the design of materials, color, and architecture of the catenary termination is critical to creating an visually attractive structure.

5.12.4.4 Parapet Walls and Protective Fencing

A protective fence on top of the low parapet wall around the boat section is required for pedestrian safety due to the presence of electric wires and vehicles traveling in the boat section. The parapet wall would be approximately 24 inches in height and 12 inches wide. A six foot high fence would be located on top of the parapet wall and would be visually transparent to allow sunlight to reach adjacent planting areas and walkways. The visual impact of the fence and parapet wall is moderate. Cladding the parapet wall with granite and utilizing a high quality ornamental steel fence would mitigate visual impacts.

5.12.4.5 Surface Station

A surface level transit stop for both north and southbound service would be provided at the intersection of the portal ramp and Washington Street. The visual impact of the transit stop is moderate because it replaces an area that is currently used for parking with high quality materials and landscaping. Over the long term, construction of an air rights development over the portal and boat section would further minimize the visual impact of the surface station. The surface station, along with portal ramps, would occupy a hotel parking area with 14 parking spaces. Design elements of the transit stop include:

- Bus Shelters – A shelter for weather protection would be provided for both northbound and southbound passengers. The shelters would match those already in use under Phase I. (See Figure 5.12-1.)
- Lighting – Site lighting would be provided from ornamental fixtures on ornamental poles to match existing lighting on Washington Street.
- Landscaping – In combination with ornamental fencing, deciduous tree plantings and groundcovers would be installed to visually and environmentally buffer the surface stop from the adjacent hotel parking area and to provide shade along a portion of a rehabilitated pedestrian pathway connecting Tremont Street to Washington Street. Tree species will complement the existing plantings on Washington Street.
- Platforms – Passenger platforms would be 15 feet wide and paved with accessible concrete unit pavers in a patterned design. Tactile warning pavements would be installed next to travel ways. Concrete bollards and tactile warning pavements would be installed on public sidewalk areas at the interface with the bus ramp to Washington Street.

Typical Kiosk

Melnea Cass Blvd. Station

Figure 5-12-1
Silver Line
Bus Shelters

Several components discussed above comprise the portal and adjacent areas. Refer to Figure 5.12-2 for an illustration.

5.12.4.6 Pedestrian Path

An existing, non-accessible pedestrian path connecting Tremont Street to Washington Street through existing parking lots would be replaced with an accessible and lighted path along the side of the NEMC parking garage. The paving material would be concrete to match adjoining sidewalks. The landscaped path would be accessible from the platforms and would be a minimum of 12 feet wide. The path represents an accessible amenity and the visual impact is low.

5.12.5 Columbus Avenue Portal

The 360-foot long boat section that comprises the Columbus Avenue portal brings the Silver Line Phase III vehicles to the surface in the block of Columbus Avenue between Arlington Street and Berkeley Street. Columbus Avenue in this area experiences moderate to heavy pedestrian traffic and heavy automobile traffic depending on time of day. The visual quality of the immediate area to be occupied by the proposed portal and boat section is low, as it is currently two lanes of existing westbound traffic on the north side of Columbus Avenue. Several adjacent buildings and the sidewalk will have views toward the portal and boat section. The surrounding buildings occupy a moderately dense office and commercial zone of the city with several different architectural periods represented, ranging from nineteenth century to modern.

The components discussed below comprise the Columbus Avenue portal and adjacent areas. Several components discussed below comprise the portal and adjacent areas. Refer to Figure 5.12-3 for an illustration.

5.12.5.1 Portal

The portal is the opening through which transit vehicles enter and exit the tunnel. It is located below grade approximately just west of the intersection between Columbus Avenue and Stuart Street and is not visible from adjacent streets. The visual impact is low to none.

5.12.5.2 Boat Section

The boat section is an inclined two-lane roadway transitioning from the tunnel to surface elevation over a distance of approximately 360 feet. There are concrete walls from the roadbed to the surface. These walls act to retain earth and the entire structure resembles an open-roofed ramp descending from grade to a tunnel opening. Since most or all of the boat section is below grade the resulting visual impact is low to none.

5.12.5.3 Catenary

The catenary or trolley wires in this alternative continue the length of the boat section to a point approximately 75 feet before the intersection with Berkeley Street, where the wires terminate in a metal frame. The wires, two for each lane, are suspended from attachments along the side of the boat section. As the ramps ascend toward grade, the catenary would be suspended from poles. The MBTA would work with BTD to have these poles be consistent with their street lighting standards. The visual impact of the terminus of the catenary system is moderate to high depending on the angle of view. When viewed from the front, a large sign banner with attractive graphics between the two terminating poles, along with ornamental lighting, would be designed to mitigate the visual impact. When viewed from behind, several insulators for the trolley wires will be visible. Careful attention to the design of materials, color, and architecture of the catenary termination is critical to creating a visually attractive structure.

Figure 5.12-2
Proposed NEMC Portal
Photo Simulation

MASSACHUSETTS BAY
TRANSPORTATION
AUTHORITY

SILVERLINE

Figure 5.12-3
Columbus Portal
Proposed Photo Simulation

5.12.5.4 Parapet Walls and Protective Fencing

A parapet wall is proposed along the sidewalk adjacent to the boat section. A protective fence on top of the parapet wall is required for pedestrian safety due to the presence of electric wires and vehicles traveling in the boat section. The parapet wall would be approximately 18 to 24 inches in height and 12 inches wide and made of cement concrete with chamfered edges. A six foot high fence would be located on top of the parapet wall and would be visually transparent to allow light and air to reach the sidewalk. The visual impact of the fence and parapet wall is high because the fence is located along 360 feet of a public sidewalk. Cladding the parapet wall with granite and utilizing a high quality ornamental steel fence would mitigate visual impacts.

5.12.5.5 Surface Stops

A surface level transit stop for outbound service is provided near the intersection of Columbus Avenue and Berkeley Street adjacent to the Salvation Army Headquarters building. The visual impact of the transit stop is low as it occurs on an existing sidewalk with a width of approximately eight feet allowing only a sign and sign post indicating the stop. Two stops for inbound service are planned. The inbound bus stops would be located on Berkeley Street south of Columbus for Dudley service and on Columbus Avenue west of Berkeley Street for Back Bay service. Both of these stops occur on city sidewalks adjacent to surface parking lots and the width constraints only allow a sign and post indicating the stop. The visual impact of these bus stops is low.

5.13 Safety and Security

Components of the operation of the Silver Line Phase III project could have potential safety effects. These include impacts to passengers, as well as MBTA employees. This section discusses the potential safety impacts of the proposed project. In order to promote safe use of the proposed system, a number of factors would be important to consider as part of the project design and operational specifications.

Specific safety standards will be incorporated into tunnel and station design which promote the safe movement of passengers through the system. All connections between Orange, Green, and Silver will be fully accessible to all passengers and will utilize escalators, elevators, and ADA compliant ramps where necessary. Existing MBTA safety practices and procedures would also be implemented to ensure the safety of employees and patrons in stations and on vehicles. Following is a discussion of some of the standards, as they relate to the Silver Line Phase III project.

Station considerations include, but are not limited to, the following:

- Emergency egress (stair, elevator, and escalator capacity);
- Stairs (no-skid treads, safety nosing, railing);
- Ventilation (fresh air, and air evacuation);
- Fire protection (smoke detection, use of non-toxic and flame retardant materials, fire extinguishers);
- Lighting (adequate and emergency lighting);
- Security (security conscious design, police call boxes, station segmentation);
- Americans with Disabilities Act (ADA) compliance (elevators, tactile edging along platform, etc.); and
- Signage (exit, fire alarm, police call box, etc.).

Due to the locations of the proposed Silver Line stations in relation to the Orange and Green Line stations, several instances may occur in which long corridors are required to provide connections between Silver and Orange/Green. In such cases, each will be designed individually to ensure the best possible sight lines for passenger security and will be sloped (if necessary) to meet ADA requirements. Intelligent use of materials and lighting also contribute to the level of safety within these spaces. A further level of passenger security will be achieved through a closed circuit television system canvassing key areas of each station that will be monitored by MBTA Police.

As dictated by NFPA 130, sprinkler systems would not generally be used within tunnel fixed facilities. Rather, a dry standpipe fire suppression system would be required. Each station would consist of a separate zone and would have a separate system feed. Other safety measures would be required with respect to vehicles, mechanical rooms and other technical components, tunnel sections, and in other appropriate areas as required by applicable standards (i.e. FTA, NFPA, Boston Fire Department, Boston Building Department, etc.).

The MBTA will employ security measures at the portals and within the tunnels similar to Silver Line Phase II. The MBTA will install an Integrated Security System at the portal and throughout the tunnels. Primary elements of this system include Portal and Tunnel Security, Closed Circuit Television, and Access Control. The objectives of this system are to prevent unauthorized vehicles from entering the tunnel, detect unauthorized pedestrians entering the tunnel from any of the stations, provide CCTV coverage of selected areas, and prevent unauthorized persons from gaining access to certain areas. Furthermore, the portal entrances will have a two gate system similar to the Silver Line Phase II D Street portal. One of the gates will be made out of steel and will have a lock. This gate will be used during non-revenue hours to keep the tunnel secure. A second gate will be made from a much lighter material that opens and closes for each passing vehicle during revenue hours. This second gate is used only as a warning for approaching unauthorized vehicles not to enter.

5.13.1 Emergency Egress

Emergency egress locations must accommodate the evacuation of all waiting passengers in underground stations together with all passengers on vehicles stopped in a station. The National Fire Protection Association (NFPA) code (130), Standard for Fixed Guideway Systems, provides for a series of calculations to determine appropriate assumptions for the number of people that must be evacuated in case of emergency and provides an additional set of calculations to be used in determining the number of egress components required. An integral part of these calculations includes projected ridership and the frequency of train service.

5.13.1.1 Chinatown Station

Peak station occupancy, for Orange and Silver Lines combined, is expected to occur during the afternoon rush hour when a total of 24,500 passengers will be either on a platform or en route to one. For the Silver Line, this period will require 74 vehicles to serve, in both inbound and outbound directions, a total of 10,957 passengers on board and 3,672 passengers waiting to board buses. Based upon NFPA 130 timed egress requirements and level of passenger service standards, the current street entrances are adequate to accommodate egressing passengers, so long as the Orange Line emergency exits at La Grange Street and Hayward Place, or other exits of equivalent egress capacity, are operational.

5.13.1.2 Boylston Station

Peak station occupancy, for Green and Silver Lines combined, is expected to occur during the afternoon rush hour when a total of 13,253 passengers will be either on a platform or en route to one. For the Silver Line, this period will require 74 vehicles to serve, in both inbound and outbound directions, a total of 6,035 passengers on board and 1,653 passengers waiting to board

buses. Based upon NFPA 130 timed egress requirements and level of passenger service standards, a combination of two escalators and two stairs from the Silver Line mezzanine to grade is required. One of the two stairs is intended to be an emergency stair and, similar to the Boylston Station Silver Line entryway, will be located along the 80-176 Boylston block.

5.13.2 Ventilation

Environmental systems would be in place to provide patrons and MBTA personnel a reasonable degree of comfort and safety by controlling factors including air temperature, air velocity, and air pressure, and by providing adequate provisions for emergency fire safety.

5.13.2.1 Normal Operations Ventilation

Ventilation during normal operation is provided by the "piston effect" of the vehicles moving through the tunnels. To facilitate this effect, the emergency ventilation shafts to be located near the ends of the station platforms usually are constructed to operate like passive air exchange shafts during non-emergency operation. Thus, as a vehicle moving through a tunnel approaches a station, some of the air in front of it is forced into the shaft where it exits to the atmosphere. In addition, air is also forced into the station and out the exits. Subsequently, when the vehicle leaves the station, outside air is drawn into the tunnel through the entrances and shafts.

When a vehicle is dwelling in the station, large amounts of heat are produced by the propulsion and air conditioning units. During the summer months, especially during rush hour, this heat can elevate the temperature in the station several degrees above the outside temperature. To help mitigate this heat buildup, most modern tunnels have overhead or platform trackbed exhaust systems to extract vehicle heat before it enters the station. Some systems, depending upon the climate, also have mechanical cooling. A detailed study of normal ventilation requirements would be performed at a later stage of design, to determine specific climate control needs.

5.13.2.2 Emergency Ventilation

During fire emergencies, the ventilation system should provide a safe path of egress for the passengers involved in fire/smoke emergency, as well as a clear access path for fire fighters. In a situation where a vehicle may be burning in a tunnel between two stations, the path of egress is achieved by forcing air past the burning vehicle such that smoke and hot gasses are forced away from other vehicles involved in the incident, and opposite the path of passenger evacuation. In vehicular tunnels, it is assumed that any vehicles in front of the burning vehicle would proceed, while those behind the burning vehicle would be held.

If a fire/smoke emergency were to occur in a station, emergency ventilation measures would be required to provide for fresh air to be drawn in through the station's entrances; smoke and hot gasses would be exhausted by the emergency fans located in the tunnel, a short distance from each end of the platform. This design provides a clear path of ingress/egress via the station's stairways and tunnel vent shafts.

5.14 Energy

This section documents the impact of the project on transportation-related energy consumption. Energy consumption changes are attributable to changes in volume, speed, distance traveled, vehicle mix, mode type and thermal value of the fuel being used. Indirect energy consumption is a function of the non-recoverable, one-time energy expenditure that would be used to construct the physical elements of the project such as the underground tunnel and stations. Calculation of

energy consumption is based primarily on vehicle miles traveled (VMT). Changes in the VMT contribute greatly to changes in energy consumption, while other factors have a lesser effect.

5.14.1 Long Term Effects

Regional VMT data were provided by the Central Transportation Planning Staff (CTPS) as calculated through the regional travel demand model for the Eastern Massachusetts Regional Planning Project (EMRPP) region. This region encompasses the 164 cities and towns of Eastern Massachusetts. Because the EMRPP model reports daily VMT, an annualization factor of 295, the conventional Boston regional annualization factor, was applied to calculate annual VMT.

The regional annual VMT for the No-Build Alternative was calculated to be 31.3 million. All of the Phase III Build Alternatives would produce a reduction in regional vehicle miles of travel which would result in a net benefit effect on energy use in the region (see Table 5.14-1).

Table 5.14-1 – Regional Annual VMT for Silver Line Phase III Alternatives

Alternative	Regional Annual VMT	Reduction in Regional Annual VMT Compared to the No-Build
No-Build Alternative	31,308,910,500	
Tremont Street Alternative	31,296,107,500	23 million
Charles Street Alternative	31,296,107,500	23 million
Stuart Street Alternative	31,296,107,500	23 million
Columbus Avenue Alternative	31,295,252,000	23 million

Source: CTPS

5.15 Secondary and Cumulative Impacts

Phase III of the Silver Line is not expected to result in secondary and cumulative impacts beyond those already analyzed both as part of project planning and as documented in this SDEIS/EIR.

Secondary or indirect impacts refer to those impacts that "are caused by the action and or later in time or farther removed in distance, but are still reasonably foreseeable future. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population destiny or growth rate, and related effects on air and water and other natural systems, including ecosystems."[14]. Overall the adverse direct impacts of the project as documented in this SDEIS/EIR would be minimal, and the indirect impacts would be positive. The Silver Line Phase IIII project is projected to have a positive indirect impact on land use within the City of Boston by supporting new development within the project corridor consistent with the policies of the BRA that encourage the strongest possible relation of development to transit, both at the overall density allocation scale, and at the detailed scale of planning for individual pedestrian ways and pedestrian open spaces. The Silver Line project is needed to support the transportation demands of future development in the corridor, including the large-scale Columbus Center project. As discussed in other sections of Chapter 5, the project will support local land use policies by creating transit linkages between key activity centers, improve travel mobility for minority and low-income residents, reduce regional VMT and energy demands, and reduce

[14] Council on Environmental Quality, *Regulations for Implementing the Procedural Provisions for the National Environmental Policy Act*, section 1508.8

regional emissions of ozone-forming pollutants as a result of reductions in vehicle traffic. The MBTA will coordinate with the Boston Groundwater Trust and design and construct the tunnel to eliminate any free water leakage and to minimize and mitigate seepage to the maximum extent feasible to minimize indirect impacts to abutting properties.

Cumulative impacts are defined as the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" [15]. As documented in this SDEIS/EIR, the project would for the most part result in minimal adverse impact. All Phase III analyses, including traffic as documented in Section 5.4 and air quality impacts as documented in Section 5.5, have assumed "past, present and reasonably foreseeable" future development within the study area in the analysis of impacts. Planning and analysis for the Phase III project as well as for Phases I and II has assumed both existing and anticipated population and employment projections and land use development in the Boston Metropolitan Region, the Boston Core, and the Silver Line corridor, as forecast by the Metropolitan Planning Area Council and the Boston Redevelopment Authority, respectively, over the next two decades. Given the minimal direct adverse impact associated with the project, and the incorporation of "past, present and reasonably foreseeable" actions into the analysis, Silver Line Phase III is not anticipated to result in cumulative adverse impacts.

5.16 Comparison of the Core Tunnel Segment Impacts to the 1993 FEIS/FEIR Alignment

The Core Tunnel Segment is substantially similar to the alignment that was reviewed in the prior 1993 FEIS/FEIR, with the exception of changes that were made to reduce impacts to important historic and parkland resources by eliminating virtually all construction of new tunnels below the Boston Common. In 1994 the FTA issued a ROD for the 1993 FEIS/FEIR alignment, concluding NEPA review, and the Massachusetts Executive Office of Environmental Affairs issued a Certificate of Adequacy, concluding MEPA review. This section describes how changes to the 1993 alignment, resulting in the present Core Tunnel Segment, have reduced the environmental impacts of the approved alignment still further.

Because they are located underground, both the 1993 alignment and the current Core Tunnel Segment would have extremely limited long-term environmental impacts. Neither alignment would have any permanent traffic, noise, vibration, air quality or environmental justice impacts. Potential visual impacts would be limited to above-grade station improvements at Chinatown and Boylston Stations. Potential impacts to natural resources would also be minimal. A CZM Consistency Determination was received from the Massachusetts Office of Coastal Zone Management in 1998, which incorporated the portion of the Silver Line Phase III Essex Street alignment within the coastal zone. Potential construction impacts, discussed in detail in Chapter 6, would be reduced for the Core Tunnel Segment from the level previously reviewed for the Boston Common

Potential land use impacts, including takings and easements, would also be the same level as previously reviewed. The 1993 FEIS/FEIR document noted that at the Boylston Station location, some small new structures would be required to meet requirements for emergency egress, emergency ventilation and access, but no specific locations were identified in the previous document. This SDEIS/EIR has identified preliminary locations for these emergency egress, emergency ventilation, and access structures, both on the Boston Common and within the Piano Row historic district (see Section 3.4.)

[15] Ibid. section 1508.7

The major difference between the 1993 FEIS/FEIR alignment and the current Core Tunnel Segment is the significant reduction of impacts to parklands and cultural resources associated with the new design. The 1993 FEIS/FEIR alignment included a large turnback loop to be constructed below the Boston Common in the vicinity of the Central Burying Ground. This loop would have had significant adverse effects on both of these important resources. The current Core Tunnel Segment relocates the turnaround loop from under the Boston Common to within the Boylston Street right-of-way, thereby minimizing impacts to the Boston Common and eliminating any impacts to the Central Burying Ground. A PA will be executed to address the specific historic and archaeological resource issues of the selected preferred alternative (see Section 5.10).

5.17 Mitigation Summary

This section describes the proposed mitigation measures and improvements proposed to offset the permanent environmental impacts of the Silver Line Phase III Build Alternatives.

5.17.1 Land Takings and Displacements

Acquisitions of all real property and easements would be completed in accordance with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all business relocations without discrimination.

5.17.1.1 New England Medical Center Portal Property Takings

The BRA would be compensated for the ROW taking. The NEMC portal would be designed to not preclude future air-rights development above the portal by the BRA. No mitigation is anticipated for the taking of the Auto Parks Parking business because it is leased from the BRA, pending future development of the parcel.

The Doubletree Hotel would be compensated for the Silver Line ROW occupying the hotel property. The MBTA would work with Doubletree Hotel to reconfigure parking on the parcel to replace the 14 spaces lost, or provide replacement parking in nearby facilities.

5.17.1.2 Columbus Avenue Alternative - Access Impacts

Access to off-street parking and loading docks from Columbus Avenue for the Salvation Army Headquarters Building (155 Columbus Avenue) and Benjamin Franklin Smith Printers (147 Columbus Avenue), which would be lost as a result of implementation of the Columbus Avenue Alternative, would be replaced with a new access from Stuart Street. The one-story building at 320 Stuart Street would be removed to create an access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drives.

5.17.2 Vehicular Traffic

Mitigation measures for permanent impacts are summarized here; mitigation measures for construction period impacts on vehicular traffic and pedestrians will be addressed as part of the Construction Management Plan.

5.17.2.1 NEMC Portal Alternatives

- An exclusive left-turn lane for Silver Line vehicles would be provided on Washington Street to manage access to the portal.
- Sidewalk improvements and pedestrian safety measures would be installed in the vicinity of the portal.

5.17.2.2 Columbus Avenue Alternative

- Proposed intersection improvements at the Arlington/Columbus/Stuart (see Figure 5.3-7) intersection would improve LOS and also improve traffic and pedestrian safety
- The current fire pre-empt signal operation would be modified to ensure that Boston Fire Department fire trucks can effectively exit the station and travel in both directions on Columbus Avenue (westbound fire trucks will be allowed to utilize the available bus lanes).

5.17.3 Pedestrian, Transit and Bicycle

5.17.3.1 NEMC Portal Pedestrian Improvements

Pavement markings, bollards, signs, lighting and audible warnings would be installed to mitigate risks to pedestrians from transit operations. Sidewalks on the west side of Washington Street in the vicinity of the portal driveway opening are currently 13 feet wide; they should be widened to 16 feet or more, and a parking lane would be removed to increase pedestrian safety.

A pedestrian crosswalk would be located at the portal entrance (west side of Washington Street) in order to facilitate pedestrian movement to and from the Silver Line station location within the portal. Improvements to the crosswalk in front of the NEMC parking garage ramps would increase pedestrian safety. The roadway in front of the portal and parking garage exits could also be equipped with traffic calming features with the objective of encouraging lower vehicle speeds. Traffic calming features would be designed around the needs of emergency vehicles.

An existing, non-accessible pedestrian path connecting Tremont Street to Washington Street through existing parking lots would be replaced with an accessible and lighted path along the side of the NEMC parking garage.

5.17.3.2 Columbus Avenue Pedestrian Improvements

Improvement to the intersection and four street corners of the Columbus Avenue/Berkeley Street intersection would be installed to create a pedestrian-friendly environment. Contrasting pavements would be used through the intersection as a traffic calming measure and to increase driver awareness. Where Silver Line bus stops would be located on three of the four legs of the intersection, well-designed crosswalks, properly timed pedestrian signals, and clear signing would be installed for pedestrian safety and mobility.

5.17.4 Noise and Vibration

No long-term noise or vibration impacts are anticipated; therefore no mitigation would be required. Construction period impacts would be addressed through the Construction Management Plan (see Section 6.9 for additional discussion).

5.17.5 Geology and Groundwater

To address potential groundwater issues, designers will install observation wells along the proposed alignment and at other selected locations near the alignment. These locations will be determined in coordination with Boston Groundwater Trust. These wells will provide a means to collect groundwater data before and during construction and to monitor groundwater levels on a regular basis after construction has been completed. In addition, the design and construction will avoid any free water leakage and minimize seepage to the maximum extent feasible. Three general waterproofing methods will be used to mitigate seepage: waterproofing membrane around mined tunnels; waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls; and special detailing at the connection of mined tunnels to tunnels constructed inside slurry walls (cut-and-cover sections).

5.17.6 Water Quality

Stormwater runoff from the boat ramp section of the portal would be intercepted prior to the tunnel, routed through a deep-sump catch basin, and then discharged to the City of Boston's storm sewer system. Best Management Practices (BMPs) as required by the Boston Water and Sewer Commission (BWSC) for street-maintenance activities, including street sweeping and cleaning of catch basins, would be employed to minimize any potential water quality impacts associated with the runoff. In addition, a drainage system would be constructed within the tunnel to capture any potential intermittent flows generated from such sources as tunnel structure seepage, vehicle drippings, tunnel washing operations, and so forth.

5.17.7 Cultural Resources

The MBTA will work with the MHC, Boston Landmarks Commission, and Boston Parks and Recreation Department to develop a process to ensure compatibility of Silver Line elements with the cultural resources in the corridor through design and construction. This process will be spelled out in a formal Programmatic Agreement (PA) signed by all parties. The MOA will also address the accessibility and fire code requirements related to the existing Green Line station area on the Boston Common.

For aboveground resources, long-term visual impacts will be limited to locations of permanent surface elements and will be mitigated by location and design that is sensitive to the adjacent historic resources and meets the Secretary of the Interior's Standards. In addition, survey and National Register evaluation of any additional properties that appear to be more than 50 years old and that have not been surveyed, as well as National Register evaluation of the previously surveyed historic resources, will be conducted under the PA for the preferred alternative alignment corridor.

For archaeological resources, additional archival and geotechnical research to determine the precise horizontal location and vertical depth of archaeologically sensitive strata within the Silver Line Phase III preferred alternative alignment would be conducted. This research would include a review of all soil borings conducted for the project, current underground utility locations, and street widening plans and profiles. The additional research and subsurface testing program(s) would need to be conducted under an archaeological permit issued by the State Archaeologist/Deputy State Historic Preservation Officer, in accordance with the project's PA

stipulations for the protection of archaeological resources, including consultation and review by the Wampanoag THPO.

Once a preferred alternative is selected, an intensive (locational) survey would be coordinated with the State Historic Preservation Officer (SHPO), FTA, and MBTA, and undertaken in accordance with the standards of the MHC, the State Archaeologist's permit regulations, the Secretary of the Interior's Standards and Guidelines for Identification, and the National Park Service guidelines for assessing eligibility for listing in the National Register. If resources identified are determined eligible for listing in the National Register, the SHPO would be consulted to determine where any project effects can be prudently or feasibly avoided, minimized, or mitigated. The findings of the above ground and archeological evaluations of the Preferred Alternative will be presented in the Supplemental Final EIS. This Section 4(f) statement will be circulated with the Supplemental Final EIS.

5.17.8 Parklands

As described above, the MBTA will work with the MHC, Boston Landmarks Commission, and Boston Parks and Recreation Department to develop the design of surface elements in Boston Common required for the Silver Line Boylston Station and the associated upgrading of the Green Line station in a manner compatible with the historic character of the resource. To further reduce visual impacts on the Common, the MBTA, in conjunction with the Boston Landmarks Commission, will seek approval from the Massachusetts Department of Public Safety to allow the use of a pop-up hatch for emergency egress, in place of the open stairwells that are currently proposed. Other than the proposed structures on Boston Common, there would be no long-term impacts to parklands associated with any alternative; therefore, no mitigation is proposed.

The construction staging plan proposes the construction period use of a portion of the Boston Common. (See Chapter 6). There would also be potential construction impacts to Elliot Norton Park caused by the Charles Alternative, which would be entirely mitigated. Once construction was complete, all parklands affected by construction period impacts would be restored to their original condition, with the possibility of additional improvements to their design, landscaping, and facilities.

5.17.9 Visual and Aesthetics

In addition to the design of structures on the Boston Common discussed above, the visual impacts of free-standing structures, catenary and parapet walls associated with the portal at NEMC or Columbus Avenue would be mitigated through careful attention to architectural design, detailing, materials, security and placement relative to adjacent views and structures.

5.17.10 Safety and Security

Specific safety and security standards will be incorporated into tunnel and station design which promote the safe movement of passengers through the system. Existing MBTA safety practices and procedures would also be implemented to ensure the safety of employees and patrons in stations and on vehicles.

5.17.11 Construction Management

A Construction Management Plan will be developed to address all aspects of construction including potential traffic, noise, and vibration impacts and mitigation strategies (see Section 6.13). A proactive strategy of building and maintaining ongoing dialogue between the Community Liaison and impacted residents will ensure that construction related issues are efficiently addressed. A multi-tiered community involvement plan will be implemented to provide the best possible experience for each impacted residential community and business. This plan will include

working with the City of Boston Transportation Department to prepare a comprehensive Construction Management Plan; coordination with the Boston Groundwater Trust; meeting with affected businesses in advance of construction to discuss the likely impacts and to obtain feedback and respond to questions and concerns generated by the impacted parties; and providing access to a Community Liaison to respond to questions and concerns. Mitigation requirements will be written into construction contracts.

Chapter 6.0 Construction Impacts

6.1 Introduction

This chapter describes the construction period impacts associated with the construction of the Silver Line Phase III Build Alternatives. The Silver Line Phase III Core Tunnel Segment and alignment alternatives have been planned to minimize impacts by providing a tunnel design that is within the right-of-way (ROW) of major streets. In areas where there is a narrow ROW, the inbound and outbound tunnels have been stacked to further avoid unnecessary impacts to abutting properties. Construction methodologies for the Core Tunnel Segment and alignment alternatives are discussed in Section 6.2, while potential staging areas are discussed in Section 6.3. Historic and archaeological resource impacts are discussed in Section 6.4 and parkland impacts are discussed in Section 6.5. Sections 6.6 through 6.12 discuss utilities; excavate characteristics, quantities and disposal options; construction dewatering; noise and vibration; traffic; air quality, and rodent control during construction. A summary discussion of construction mitigation is presented in Section 6.13.

6.2 Construction Methodology

This section describes the proposed techniques to construct each of the alignment alternatives for Silver Line Phase III. The methods were selected to minimize surface and below-grade impacts to buildings, pedestrians and vehicular traffic; minimize groundwater depletion and excavate quantities; avoid disruption of existing transit operations and utility service; and to accommodate construction within the dense urban environment in downtown Boston. Construction techniques would be similar for all alternatives; however, the specific application and the extent of each construction technique would vary. Since a preferred alternative has not been selected, the specific application of the individual construction techniques has not yet been determined for this Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR). Specific construction techniques will be determined during the final design for the preferred alternative, and will be based on a number of factors including soil conditions, depth of tunnel, alignment geometry, staging site and equipment availability, and schedule and cost implications.

All of the Silver Line Phase III Build Alternatives involve tunnel construction with a ramp to the surface at the portal location, and therefore all of the alternatives have similar construction phase impacts for the most part. Construction phase impacts that differ among the alternatives have been noted. The construction period for any of the Silver Line Phase III Build Alternatives is estimated to be approximately four to six years depending on staging site availability, ground conditions, and progress of work.

The following construction techniques will be utilized throughout the Silver Line Phase III project on different portions of the project, regardless of the alternative that is selected as the preferred alternative. Figures 6.2-1 through 6.2-4 identify the proposed alignments, construction methods, and proposed construction staging sites for each Build Alternative. A technical description of each construction technique discussed below (e.g., mining, tunnel boring, and cut-and-cover) is provided in Technical Appendix H.

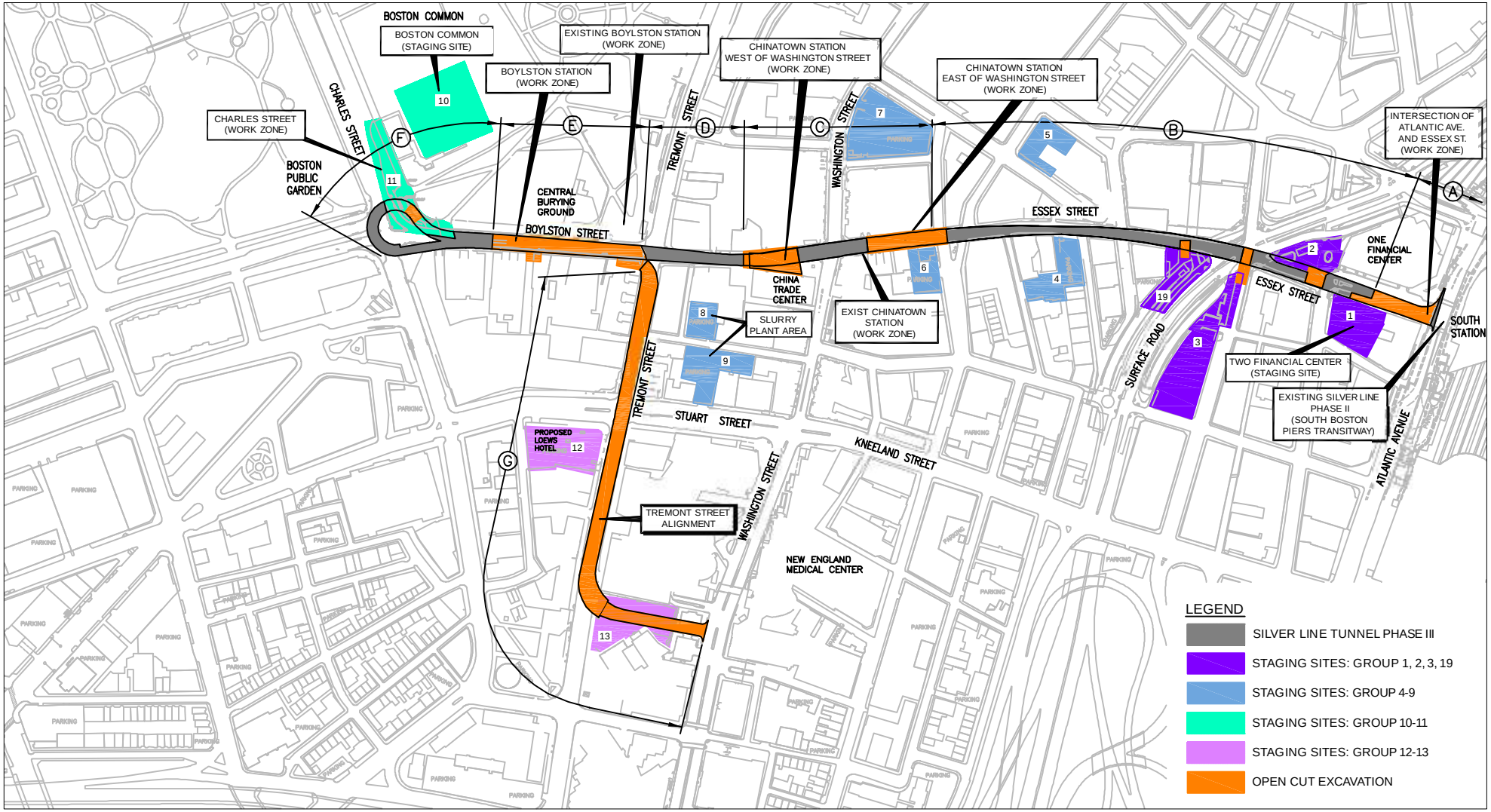

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Figure 6.2-1
Work Areas - Core Tunnel and Tremont Street Alignment

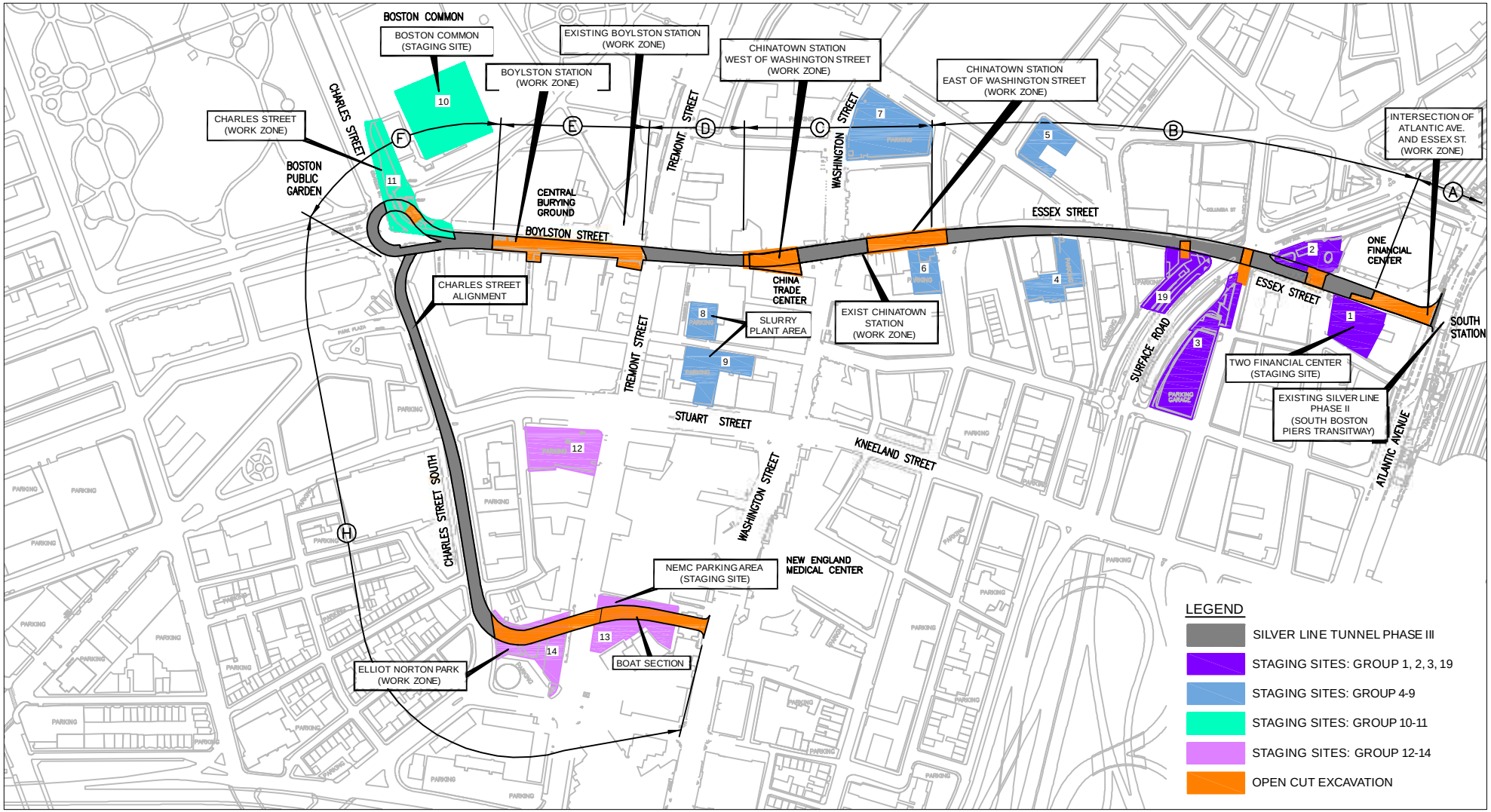
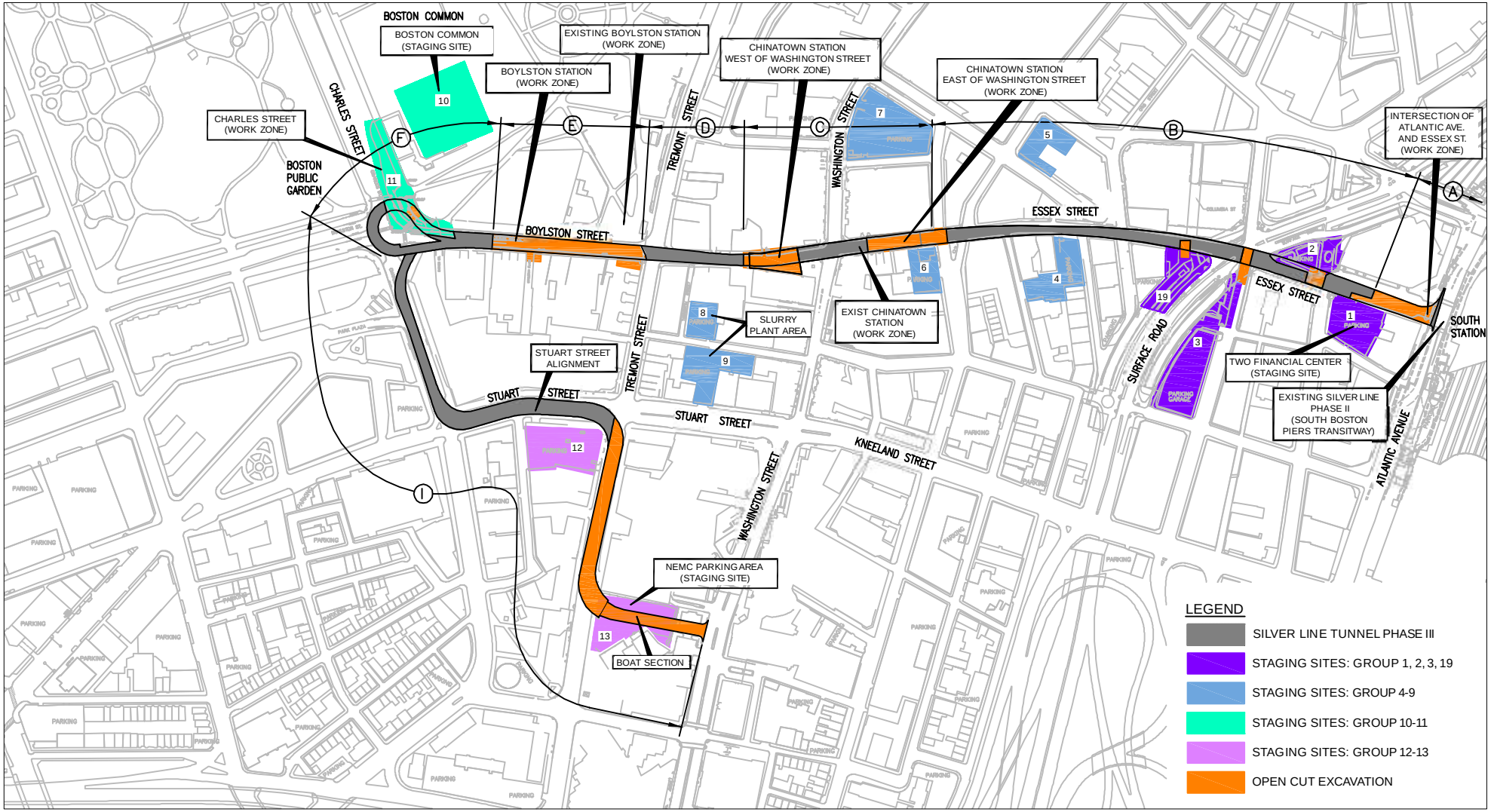


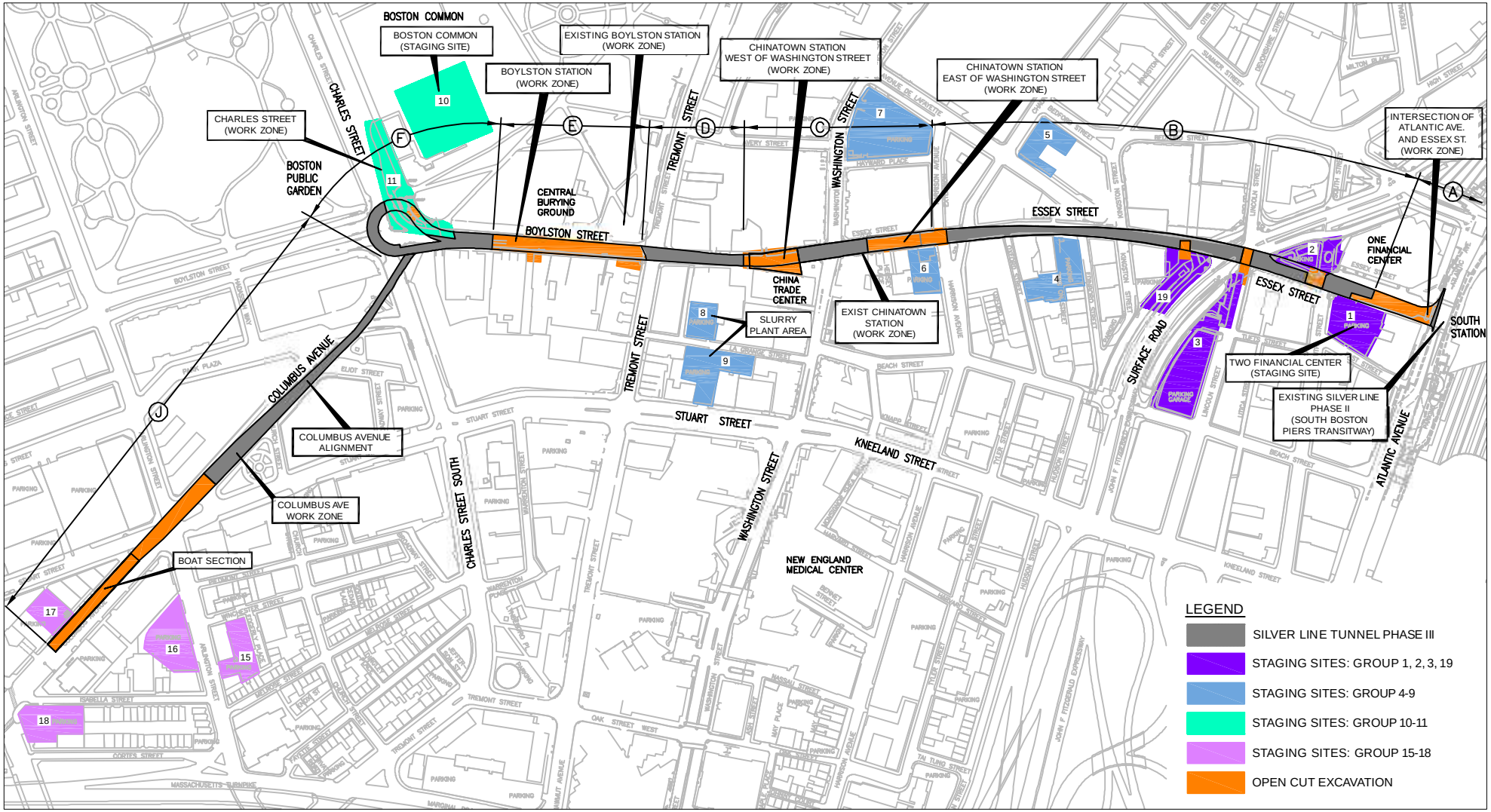
Figure 6.2-2
Work Areas - Core Tunnel and Charles Street Alignment



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 6.2-3
Work Areas - Core Tunnel and Stuart Street Alignment



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SILVERLINE

Figure 6.2-4
Work Areas - Core Tunnel and Columbus Avenue Alignment

6.2.1 Tunnel Construction

Much of the tunnel alignments would be mined under the streets, with soil stabilization to minimize impacts on the surface. Mining is a construction technique that uses machines to excavate soil and progress to the limits of the tunnel cross-section with minimal surface penetrations to provide access for equipment and tunnel material and to remove soil. Mined tunneling is an appropriate technique for dense urban areas, since tunnel mining equipment can maneuver curved and non-continuous sections and require smaller staging areas than other tunneling methods. In addition, this method is not restricted to commencing at the tunnel end points, and therefore mining activities can take place in two directions, which can minimize construction duration.

An alternative method to tunnel mining would be the tunnel boring technique, which uses a tunnel boring machine (TBM). Although faster than mining, this method is best suited for long continuous sections of tunnel with a uniform cross section. Additionally, it requires relatively large staging areas at the beginning and end of the tunnel for equipment access and soil removal. Due to the congested surface conditions and the tunnel configurations for the Silver Line Phase III alignment alternatives, this technique may not be suitable for use on any portion.

Where mined or bored tunneling methods are not appropriate, cut-and-cover methods of construction would be used. Cut-and-cover refers to placing a perimeter excavation support wall, such as a slurry wall, around the area to be excavated. The tunnel structure would be built in the excavated area and then backfilled to restore the surface. If the location of this type of construction is in a street, temporary decking can be placed over most of the excavated area to maintain traffic at the surface while work proceeds below.

As mentioned above, slurry wall methods would be used for support of excavation for cut-and-cover operations of the tunnels and stations. Slurry is a water clay mixture that is used to keep an excavation hole open. The wall is constructed by first excavating down to the depth that the wall needs to be using a clam-shell type excavator. While the excavation is proceeding, slurry is placed in the hole to prevent it from caving in. Once the hole is excavated the wall is constructed in one of two ways. In the first method, a steel cage of reinforcing bars can be lowered into the hole, and placed into position. Concrete is then pumped to the bottom of the wall. As the level of concrete rises, the slurry is removed from the hole at the surface. Alternatively, Solder Pile and Tremie Concrete (SPTC) construction requires the use of steel sections inserted in the wall instead of steel reinforcement bars; the concrete would be placed in the same manner as previously discussed.

Table 6.2-1 summarizes the construction techniques to be used for each of the stations and proposed alignments. The construction work area designations correspond to the work areas shown in Figures 6.2-1 through 6.2-4.

Table 6.2-1 – Construction Method Summary

Work Area Designations	Physical Description	Construction Method
A	Essex Street and Atlantic Avenue Connection to South Station/Silver Line Phase II (Core Tunnel Segment)	Cut-and-cover excavation with slurry wall
B	Essex Street Tunnels (Core Tunnel Segment)	Mining or TBM with limited cut-and-cover areas for construction access and excavate removal
C	Chinatown Station (Core Tunnel Segment)	Cut-and-cover excavation with slurry wall and limited mining or TBM between cut-and-cover areas and beneath the existing Chinatown Station
D	Boylston Street Tunnel Section (Core Tunnel Segment)	Mining or TBM with no cut-and-cover area
E	Boylston Station (Core Tunnel Segment)	Cut-and-cover excavation with slurry wall
F	Boylston Street Tunnel Loop Section (Core Tunnel Segment)	Mining with one cut-and-cover area for construction access and excavate removal
G	Tremont Street Tunnel Section (Tremont Street Alignment)	Cut-and-cover excavation with slurry wall throughout entire length
H	Charles Street Tunnel Section (Charles Street Alignment)	Mining or TBM with cut-and-cover excavation at Elliot Norton Park and across Tremont Street
I	Stuart Street Tunnel Section (Stuart Street Alignment)	Mining or TBM along Charles Street South and Stuart Street. Cut-and-cover excavation with slurry wall along Tremont to the portal
J	Columbus Avenue Tunnel Section (Columbus Avenue Alignment)	Mining or TBM to Statler Park, east of Arlington Street; cut-and-cover excavation with slurry wall to portal at Berkeley Street

6.2.2 Demolition

Demolition activities are likely to include the use of concrete sawing equipment, impact type equipment (jack-hammers, ram hoes), cranes and trucks. The Tremont Street Alignment Alternative would require the complete demolition of the abandoned Tremont Street subway tunnel under Tremont Street from Boylston Street to the portal (approximately 1,200 feet), while the Stuart Street alignment would demolish the tunnel from Stuart Street south to the portal (approximately 700 feet). The Charles Street Alignment would require demolition of part (approximately 80 feet) of the abandoned Tremont Street subway tunnel where the proposed tunnel crosses Tremont Street near the New England Medical Center (NEMC) portal. Cut-and-cover construction would be required for those areas where the tunnel would be demolished.

Demolition would also be required at the tunnel interface with Silver Line Phase II at Atlantic Avenue and Essex Street. The new Silver Line Phase III stations at Chinatown and Boylston will require penetrations to the existing stations to provide access to the Orange Line and Green Line.

Demolition of existing above-grade structures to accommodate headhouses, vent shafts, emergency egress structures, and construction staging areas or access points is not anticipated for this project. However, if staging Site 3 is used (see Section 6.3), the existing parking garage would need to be demolished.

6.2.3 Buildings

As previously discussed, the current alignment alternatives for Silver Line Phase III have been designed to avoid, minimize, and mitigate impacts to adjacent structures. A review of the foundation systems for each of the buildings adjacent to the Core Tunnel Segment and the alignment alternatives was conducted to determine additional mitigation measures that would be required to support the buildings during construction. Building mitigation measures will be finalized after the preferred alternative is selected and the project design is further advanced. Additional mitigation measures could include protection of historic buildings as directed by the Project Conservator in accordance with the Programmatic Agreement (PA) with the Massachusetts Historical Commission (MHC). (See Section 6.4) In general, building access and operating conditions will be maintained in accordance with the Massachusetts Building Code by implementing any combination of the following mitigation measures to avoid construction period impacts. Building mitigation measures are summarized by alternative in Table 6.2-2.

Pre-Construction Survey – A final pre-construction survey of buildings and/or structures will be performed before construction starts to document any existing cracks or foundation abnormalities.

Monitoring and Instrumentation – Selected buildings along the tunnel alignment will have instruments installed throughout the building to monitor and record building behavior (movements, vibrations) during construction.

Soil Stabilization under Foundations – Soil stabilization is any physical or chemical method, or any combination of such methods, used to increase the bearing capacity or decrease the permeability of soils under the foundation of existing buildings

Compensation grouting – Compensation grouting is a specialized form of grouting used to compensate for movements and settlements caused by tunneling adjacent to or beneath existing buildings.

Table 6.2-2 – Building Mitigation Summary

Alignment	Monitoring & Instrumentation	Soil Stabilization	Compensation Grouting
Core Tunnel Segment	42	36	36
Tremont Street Alternative	19	13	13
Charles Street Alternative	22	15	14
Stuart Street Alternative	12	4	4
Columbus Avenue Alternative	13	6	6

Foundation Underpinning –Underpinning is the introduction of additional support or enlarging of the foundation elements of a building to accommodate deeper, new construction adjacent to the building. The need for underpinning is specific to the alternative. Table 6.2-3 identifies the building underpinning by alternative as required.

It is not anticipated that buildings along either the Charles Street or Columbus Avenue Alignments would require foundation underpinning.

Post-Construction Survey – A post-construction survey will be performed, as necessary, based on the observations of the pre-construction survey and the monitoring program during construction.

An additional discussion on building impacts from construction activity noise and vibration is presented in Section 6.9 below. A detailed summary of potential mitigation measures for the

buildings along the Core Tunnel Segment and each of the alignment alternatives is included in Technical Appendix H.

Table 6.2-3 – Foundation Underpinning Summary

Address	Name of Building (if known)	Type of Structure
Core Tunnel Segment		
695 Atlantic Avenue	Plymouth Rock Building	11 story building
588-622 Washington Street	Wings Comm./Federal Stationary Co.	8 story building
45 Essex Street/1-5 Harrison Avenue		2 story building
25-31 Essex Street	Honglok House	4 story building
15 Essex Street		4 story building
636 Washington Street	Liberty Tree Building	4 story building
2 Boylston Street	China Trade Center	6 story building
39 Boylston Street	St. Francis House	11 story building
51 Boylston Street/186 Tremont Street	Masonic Building	9 story building
80-84 Boylston Street	Little Building	12 story building
100 Boylston Street	Colonial Building	10 story building
120 Boylston Street	Walker Building	10 story building
132 Boylston Street		6 story building
134 Boylston Street		4 story building
140 Boylston Street		7 story building
162 Boylston Street		6 story building
2 Park Plaza/176 Boylston Street		7 story building
Tremont Street Alignment		
192 Tremont Street	Hotel Touraine	12 story building
284 Tremont Street	NEMC Garage	10 story concrete
Charles Street Alignment		***No underpinning anticipated***
Stuart Street Alignment		
284 Tremont Street	NEMC Garage	10 story concrete
Columbus Avenue Alignment		***No underpinning anticipated***

6.3 Staging Areas

Staging areas and access shafts are needed to support tunnel mining or boring operations, equipment laydown, soil stockpiling, soil mixing operations, and field offices. Staging areas are typically fenced to protect the public, material and equipment, have gates to allow vehicle access and deliveries, and are often lit for security. Staging areas of adequate size and proximity to the alignment are essential to minimize construction traffic through the city and to provide adequate space for the necessary construction activities. The location of construction staging areas is dependent on the alignment in order to provide direct access to the construction work areas. Due to the dense urban environment in downtown Boston and the proposed implementation of the Central Artery/Tunnel surface restoration, very few vacant parcels are available within proximity to each of the alignments. This section discusses potential staging sites that have been identified for the alternative alignments. Eighteen sites have been identified; however, not all sites are required nor may be available at the time of construction. In general, having more staging sites available to the construction contractor would allow more flexibility to expedite construction, resulting in a shorter construction period. The number and final locations of proposed staging areas will be refined once the preferred alternative is selected. Staging site selection will be based on cost implications, future development plans of the parcel, and availability of the parcel at the time of construction.

Properties and parcels required for the construction of Silver Line Phase III would be leased on a temporary basis for part or all of the construction period. Table 6.3-1 lists the potential staging areas and a few important work zones proposed to support the Silver Line Phase III construction activities. These sites are also shown on Figures 6.2-1 through 6.2-4.

Table 6.3-1 – Construction Staging Sites Summary

Staging Site Designation	Name/Use	Location	Work Area Supported (1)	Alternative Supported	Comments
1	Two Financial Center (potential development parcel)	Bounded by Essex Street, South Street, East Street, and Atlantic Avenue	A	Core Tunnel Segment	Needed for staging for cut-and-cover excavation at interface with Phase II tunnel.
2	Dewey Square Vent Building and portion of South Street	Northwest of Two Financial Center bounded by Surface Road, Essex Street, and South Street	B	Core Tunnel Segment	
3	Parking Garage	Bounded by Surface Road, Essex Street, Lincoln Street, and Beach Street	B	Core Tunnel Segment	Not a preferred site since it requires demolition of existing garage.
4	Parking Area	Bounded by Oxford Street, Edinboro Street, and Essex Street	B	Core Tunnel Segment	
5	Vacant parcel	Bounded by Chauncy Street, Avenue de Lafayette, and Bedford Street	B	Core Tunnel Segment	
6	Parking Area	Bounded by Hersey Place, Harrison Avenue, and Essex Street	C	Core Tunnel Segment	Needed for staging for cut-and-cover excavation of Chinatown Station.
7	Parking Area	Bounded by Washington Street, Hayward Place, Harrison Avenue, and Avenue de Lafayette	C	Core Tunnel Segment	
8	Parking Area	Bounded by Tamworth Street and La Grange Street	All	All	Needed for slurry plant operations.
9	216 Tremont Street – Parking Area	Bounded by Tremont Street, Stuart Street, and La Grange Street	All	All	Needed for staging for cut-and-cover excavation of Tremont Street tunnel and/or slurry plant operations.
10	Boston Common Baseball Field	Boston Common near Charles Street	All	All	Needed for staging for full duration of project. At the end of the project, the baseball field would be reconstructed.

Staging Site Designation	Name/Use	Location	Work Area Supported (1)	Alternative Supported	Comments
11	Free Right Turn Lane on Charles Street	Intersection of Charles Street and Boylston Street	All	All	This lane would not be required for vehicular traffic with the closure of the westbound lane of Boylston Street for the duration of construction.
12	Proposed Loews Hotel parcel	Bounded by Warrenton Street, Tremont House, Tremont Street, and Stuart Street	G/H/I	Tremont Street Alignment/ Charles Street Alignment/ Stuart Street Alignment	Needed for staging for Charles Street, Stuart Street or Tremont Street alignment
13	BRA Parcel/NEMC Parking Area	Bounded by Tremont Street and Doubletree Hotel	G/H/I	Tremont Street Alignment/ Charles Street Alignment/ Stuart Street Alignment	Needed to support the construction of the boat section[2] between Washington Street and the tunnel portal and to support mining operations underneath Charles Street South
14	Elliot Norton Park Area	Bounded by Charles Street south, Elliot Norton Park, and Tremont Street	H	Charles Street Alignment	Needed for cut-and-cover excavation for Charles Street Alignment. It is anticipated that construction in the park would be approximately 2 years.
15	Parking Area	Bounded by Arlington Street, Edgerly Place, and Winchester Street	J	Columbus Avenue Alignment	
16	Parking Area	Bounded by Isabella and Arlington Street	J	Columbus Avenue Alignment	Needed for staging for cut-and-cover excavation portion of Columbus Avenue Tunnel
17	Salvation Army Parking Area	Bounded by Stuart Street and Columbus Avenue	J	Columbus Avenue Alignment	
18	Parking Area	Bounded by Columbus Avenue, Cortes Street, and Isabella Street	J	Columbus Avenue Alignment	
19	Proposed Chinatown Park area (parcel 23)	Bounded by Kingston Street, Beach Street, Surface Road, and Essex Street	B	Core Tunnel Segment	Only the northern portion of the site would be used for construction staging and access to cut-and-cover area.

Notes:
1. Work Area Supported refers to the work areas identified in Table 6.2-1 and Figures 6.2-1 through 6.2-4
2. Boat Section refers to the transition structure between the tunnel portal and surface grade. This ramped structure most commonly consists of two tapering retaining walls on either side of the travel way slab. The structure is open to the atmosphere without a roof. The construction of a boat section is most often by open cut.

6.3.1 Easements and Acquisition

Temporary easements for the staging areas presented above in Table 6.3-1 would be acquired in accordance with applicable provisions of the *Uniform Relocation Assistance and Real Property Acquisition* Polices *Act of 1970, as amended* and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for easements on their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all businesses relocated without discrimination.

6.4 Historic and Archaeological Resources

Temporary construction-period impacts of the Silver Line Phase III Core Tunnel Segment and Four Build Alternatives that could affect significant historic and archaeological resources include impacts from mining or TBM including access shafts, cut and cover for portals and other project elements, open excavations for new station surface elements, ; station entrance/egress work within historic structures; the movement of heavy equipment needed to construct tunnels and underground stations; truck traffic; and surface level improvements, including construction staging areas. Temporary impacts could also occur from noise and vibration associated with demolition and construction activities; soil movement and settlement resulting from excavation and dewatering; and fluctuations in groundwater levels, particularly where buildings are on timber piles. Construction period noise and vibration impacts that may affect historic buildings are analyzed in Section 6.9. As discussed in Section 6.2.3, minimization and mitigation measures for buildings will include a variety of preconstruction and construction actions that will be finalized after the preferred alternative is selected. In addition, the MBTA will retain a Project Conservator to monitor mitigation measures for protecting cultural resources during construction, in accordance with the Section 106 Consultation Programmatic Agreement to be executed for the project.

Various measures may be employed to avoid, minimize and/or mitigate any adverse effects to National Register listed or eligible historic resources. During the construction period, the use of concrete decking over open cut construction areas will eliminate noise impacts. Anticipated mitigation for vibration and ground-borne noise that could affect both fragile and non-fragile historic buildings includes: 1) monitoring and instrumentation; 2) soil stabilization under foundations; 3) compensation grouting; and 4) foundation underpinning. Traffic and access impacts will occur during construction but are anticipated to be limited during operations. The agency consultation process may identify additional mitigation actions. Permanent impacts and mitigation are discussed in Section 5.10.

Any temporary construction-period impacts on historic and archaeological resources associated with the preferred alternative will be addressed in the Section 4(f) Statement to be circulated with the Supplemental FEIS/EIR once a preferred alternative has been selected and design is further advanced. See Section 5.10 for more detail on the regulatory framework for federal, state, and local agency consultation and coordination in preparing the documents and public review.

6.5 Parkland

Construction of the Core Tunnel Segment may involve the temporary use of a ballfield on the Boston Common for construction staging. In addition, the Charles Street alternative requires the

temporary use of Elliot Norton Park for cut-and-cover excavation activities. Construction phase use of parklands will only cause short term, temporary impacts to each of these parks. Since the Boston Common ball field would be used for the duration of construction, the MBTA is committed to providing a replacement ball field in an alternate location. The construction duration at Elliot Norton Park would be minimized so the park can be restored as soon as possible. Due to the expedited construction in Elliot Norton Park, a replacement park for the duration is not a feasible option. Once construction is complete, the parks would be restored to their original condition, with the possibility of additional improvements to their design, landscaping, and facilities. Any temporary construction period impacts on parklands associated with the preferred alternative will be addressed in more detail in the Section 4(f) Statement, to be circulated with the Supplemental FEIS. See Section 5.11 for more detail on the regulatory framework for that review.

6.5.1 Boston Common

Boston Common is one of the most well-known recreational resources in downtown Boston. It is also a local and national landmark and is listed on the National Register of Historic Places. Boston Common's 50 acres provide the most significant parkland area within downtown Boston, while also functioning as a neighborhood park for Chinatown, Bay Village, Beacon Hill and Back Bay[1].

The historic Boylston Green Line Station headhouses are located on the southeast corner of the Common. The Deer Park Maintenance Yard operated by the Boston Parks and Recreation Department is located along Boylston Street to the west of the Boylston Station inbound headhouse. The Deer Park Maintenance Yard is enclosed with a stone wall and contains a parking area and vent structures for the Green Line. The Central Burying Ground an important historic resource, is located along Boylston Street to the west of the Deer Park Maintenance Yard.

Boston Common hosts a ball field at the intersection of Boylston and Charles Street that is slated for temporary use as a construction staging site. It is expected that the ball field would be used throughout the construction period, currently expected to last four to six years. To mitigate the loss of the ball field during this time, the MBTA would construct a replacement ball field in a alternate location in coordination with Boston Parks and Recreation Department. After construction is complete, the MBTA will restore the Boston Common ball field to it's current configuration. Pedestrian access through and around the Boston Common will be maintained at all times during construction, as discussed in Section 6.10.

6.5.2 Elliot Norton Park

Elliot Norton Park is a public park in the Midtown Cultural District bounded by Charles and Tremont Streets to the east and west, by residential buildings (some historic) to the north, and by the United Methodist Church of All Nations to the south. Section 4.11 provides more information on the regulatory status and importance of this park to the community.

The park is of importance to construction activities since it would be temporarily used for cut-and-cover tunnel construction of a section of the Charles Street alternative. During construction, the entire park site would be cleared and reusable items carefully removed and stockpiled for later use. Construction in the park area is anticipated to last approximately two years. After construction of the cut-and-cover section of the tunnel, the site would be restored, at a minimum, to the existing configuration with new lawn, trees, walkways, and reinstalled lighting and play equipment. The temporary use and reconstruction of the park would also afford the community an opportunity to redesign and enhance the current configuration and use of the park if so desired. The MBTA is aware of the importance of the park to the community and will make every effort to expedite construction work to minimize the duration of impact.

[1] The Boston Common Management Plan. City of Boston Parks and Recreation Commission. 1996.

The construction technique in the general area of the park would be a tunnel transitioning from a depth of 30 feet below grade under Charles Street to the surface at Washington Street. The required tunnel construction method in the specific area of the park and across Tremont Street is cut-and-cover due to the shallow depth and alignment of the tunnel through the park. This method requires a deep trench to be excavated through the park, a tunnel box to be constructed in the trench, and the subsequent filling of the trench back to the original surface elevation. Heavy machinery used in the excavation of the trench and construction of the retaining walls would be located both in the trench and on the surface. This would require the removal of all surface material that makes up the park in the area of the trenching. Material storage and laydown areas supporting this section of tunnel construction (it would not be used to support construction along other areas of the alignment) will also be established for the construction period. Pedestrian accessibility to and through the park would temporarily cease.

After construction is complete, the park will be restored to its current configuration. The design and layout of the restored park would be identical to its condition today, or as an alternative, the MBTA will work with the City of Boston Parks and Recreation Department to lead a community based program to develop the new design of the park, if a different type or design is preferred. Items that could be dismantled and stockpiled would be carefully stored and reused in the park restoration. Items that could be stored include play equipment, ornamental lighting, topsoil and fencing. At least 21, but possibly more, mature trees would be removed from the site with the potential for transplanting to other City of Boston land. Trees of the same species would be installed at the time of restoration; however, the trees would be younger in order to increase transplant viability and increase likelihood of attaining matching specimens. Adequate soil depth over the new tunnel will exist to support trees and lawn: three feet of soil depth for trees and one foot of soil depth for lawn areas. A detailed existing condition survey of the park would be made prior to construction. Restoration construction plans would be presented to the community and made available for review.

The north side of Elliot Norton Park is bounded by historic residential structures and mixed use buildings that will be visually and environmentally impacted by construction operations. As a mitigation measure, a 12 foot high opaque privacy screen - designed to attenuate dust, noise, views of construction, and other impacts – would be erected along the north side of the park. A 12 foot high screen is recommended because a higher one would likely create excessive shadows, and a lower one would permit increased views and interaction with construction operations. Construction mitigation plan drawings would be prepared for review by abutters, showing the layout of the privacy screen, the construction materials, and the resulting area of shadow at different times of the year if the Charles Street alignment is selected.

6.6 Utilities

Existing utilities in most areas will be unaffected by construction of each alignment due to the depth of the tunnel and construction methodology. The Core Tunnel Segment has been designed to pass under the New East Side Interceptor (NESI) sewer along Essex Street. Therefore, no impacts to the NESI are anticipated. Construction of the Core Tunnel Segment will also take into account a major Verizon hub that is located on Essex Street at Harrison Avenue. This hub may be avoided or temporarily relocated depending on final design of the Core Tunnel Segment. Utilities located in areas where mined tunnels are used will be impacted the least. The Tremont Street and Stuart Street Alignments require complete or partial demolition of the abandoned Tremont Street Tunnel, which contains a 600kV power cable for the MBTA Green Line subway. The relocation of this cable would be coordinated with MBTA Green Line Operations. Locations where cut-and-cover construction techniques are used will require a utility support, protection and relocation plan.

Comprehensive utility relocation plans will be developed for each impacted utility. Each utility relocation plan will identify and restrict utility shutoffs so as to minimize the number of disruptions

affecting utility customers. The MBTA's design engineers will work closely with each utility provider to locate their affected utilities; plan the abandonment, relocation and/or support of each; and incorporate these requirements, methods and procedures into final construction documents. It is anticipated that, in some cases, it may be less disruptive to utility services and more cost effective to award utility relocation contracts in advance of actual tunnel construction. Due to the number and proximity of affected utilities in the downtown area, the MBTA will retain utility engineers to be assigned to the project in all areas of cut-and-cover excavation during the construction phase. Utility engineers will act as a liaison between contractors, the various utility owners, City of Boston and the affected customers to coordinate and document that the utility relocation plans were followed.

6.7 Excavate Characteristics, Quantities, and Disposal Options

This section contains a discussion of the anticipated soil excavation that will occur within the limits of construction for the Silver Line Phase III project, including the Core Tunnel Segment and the four alignment alternatives – Tremont Street, Charles Street, Stuart Street, and Columbus Avenue.

A soil management plan for the project will be developed. It will address the characteristics, initial estimates of quantities and disposal options for the soils that will be excavated during construction of the project.

As noted in Section 4.8, much of Boston, including portions of the project area, has been raised with artificial landfill. This fill is highly variable in composition from location to location, but there are two main types: granular fill and cohesive fill. Soil borings performed to date at various locations within the Silver Line Phase III corridor have shown primarily granular fill with zones of cohesive fill. The granular fill generally consists of fine to coarse sand with varying amounts of gravel and fines. Debris such as brick fragments cinders and ash, concrete, metal, wood, shells, slag, and asphalt have been encountered at many of the boring locations. Cohesive fill consists predominantly of reworked yellow clay with lesser amounts of sand, silt and other debris typical of granular fill. Granular fill is generally present to depths of 4-8 feet, with cohesive fill zones generally encountered below granular fill to depths ranging from 8-17 feet below grade.

Beneath the fill described above, zones of clay and organic silt have been encountered at some locations near the project area during the project geotechnical/environmental boring program. As described in Section 4.8, marine clay, commonly known as Boston Blue Clay, is present in the project area and has two distinct zones: an upper yellow clay and a lower gray clay.

The upper clay is as much as 24 feet thick, and is highly over-consolidated due to desiccation during a period when it was exposed above sea level. The clay in this upper desiccated crust is often distinguished by a yellow-brown color that is the result of oxidation. Based on borings from previous projects along the Silver Line Phase III corridor, this upper clay appears to be present along the entire length of Essex Street. The lower, gray clay is of low to medium plasticity with frequent sand lenses of silty fine sand measuring from 1/32 inch to 3 inches in thickness.

Glacial till beneath the clays in the project area consists of a heterogeneous mixture of sand, silt, clay, and gravel, with occasional cobbles and boulders. Along most of the alignment, the major constituent is either silty sand or sandy silt. Beneath the glacial till, bedrock consists of the Cambridge formation of the Boston Basin. The rock type is mostly Cambridge Argillite, but other rock types are also encountered.

As noted in Section 4.10, information about historical land uses near the Core Tunnel Segment and alternative alignments was gathered during a review of historical maps conducted for this project. According to these maps, development in the project area began prior to 1776, when the area was developed as city streets and adjacent city blocks with the exception of the southern

end of present day Charles Street South, which extends beyond the historic 1776 shoreline. An 1836 map of Boston indicates that this shoreline had by then been filled and developed with city streets and blocks. An 1867 Sanborn map reviewed for this project shows the area near the alignment had been developed with multi-story buildings consisting of residences, theaters, hotels, restaurants and institutions (i.e., schools, libraries and churches). Industrial uses were noted along the Essex Street Corridor from the late 1800's until the turn of the century.

6.7.1 Excavate Quantities

As described in Section 6.2, construction of the various segments of the Core Tunnel Segment and selected alternative alignments will be accomplished utilizing a combination of cut-and-cover and mined or bored tunneling methods.

The estimated soil excavate volumes presented here were developed based on the preliminary conceptual design of the Core Tunnel Segment and the alternative alignments described in Chapter 3 of this document. Volumes of "natural"[2] and "fill" soils for the core and alternative alignments are presented. For the purposes of this analysis, natural soils are assumed to be uncontaminated, while fill soils are assumed impacted with contaminants. Excavated soils may also be impacted by grout during the soil stabilization process. Grout typically increases the pH of soils. These soils will be handled in accordance with procedures described in Sections 6.7.2 and 6.7.3.

Though not included in the soil excavate volumes, asphalt, brick, and concrete rubble may also be generated by demolition activities as described in Section 6.2.2. This material will be handled in accordance with Sections 6.7.2 and 6.7.3.

Table 6.7-1 shows the total volumes of natural and fill soils associated with construction of the Core Tunnel Segment and alternative alignments.

6.7.1.1 Core Tunnel Segment

The estimated total volume of soil that would be excavated during construction of the Core Tunnel Segment between South Station and Charles Street South, including excavations for work areas A through F – South Station Tunnel, Chinatown Station, Boylston Station, and the Charles Street/Boylston Street Turnaround Loop, is approximately 211,900 cubic yards. Of this volume, it is estimated that approximately 23,400 cubic yards would be fill.

6.7.1.2 Tremont Street Alternative

If the Tremont Street alternative alignment were selected as the preferred alternative, it is estimated that the total volume of soils that would be excavated during construction (in addition to those associated with the Core Tunnel Segment) would be 98,700 cubic yards, including excavations for the Boylston Station by-pass lanes, the tunnel beneath Tremont Street, and the boat section. It is estimated that approximately 59,800 cubic yards of this soil would be fill, much of which is concrete, brick, and steel debris from demolition of the abandoned Green Line tunnel.

[2] Natural soils are defined as undisturbed soils that were not placed by human activity (i.e. fill). Massachusetts Department of Environmental Protection (MA DEP). 1995. Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan. BWSC/ORS-95-141 and associated Technical Updates.

Table 6.7-1 – Estimated Volumes of Excavated Soils (cubic yards)

Alignment		Fill [1]	Natural Ground	Total [2]
Core Tunnel Segment	South Station	5,400	7,800	13,200
	Tunnel between	0	42,200	42,200
	Chinatown Station	10,400	67,600	78,000
	Tunnel between	0	10,600	10,600
	Boylston Station	7,600	40,000	47,600
	Tunnel between	0	6,800	6,800
	Loop	0	13,500	13,500
	Total	**23,400**	**188,500**	**211,900**
Tremont	Boylston Station By-Pass Lanes	0	24,100	24,100
	Tremont Street	53,000	14,800	67,800
	Boat Section	6,800	0	6,800
	Total	**59,800**	**38,900**	**98,700**
Charles [3]	Turn towards Charles	0	13,200	13,200
	Charles Street	0	40,800	40,800
	Elliot Norton Park	1,500	4,900	6,400
	Boat Section	6,800	0	6,800
	Total	**8,300**	**58,900**	**67,200**
Stuart [4]	Turn toward Charles	0	13,200	13,200
	Charles Street	0	6,700	6,700
	Turn towards Stuart	0	9,200	9,200
	Stuart Street	0	10,800	10,800
	Turn towards Tremont and Tremont Street	53,000	0	53,000
	Boat Section	6,800	0	6,800
	Total	**59,800**	**39,900**	**99,700**
Columbus	Turn toward Charles	0	13,200	13,200
	Columbus Ave	18,900	12,000	37,900
	Boat Section	7,000	0	0
	Total	**25,900**	**25,200**	**51,100**

Notes:
1. Comprehensive geological information is not available. Depth of fill is estimated between 10 and 17 feet from existing grade. An average fill depth of 15 feet is assumed. Fill volume includes any demolition debris (e.g. Tremont Street tunnel) that could be generated during construction.
2. Volumes noted in yd^3, and are rounded up to the nearest 100 yd^3.
3. For Charles Street alignment, mined option is assumed until alignment is under Elliot Norton Park.
4. For Stuart Street alignment, mined option is assumed until alignment connects with Tremont Street.
5. Quantities are based on present in-situ conditions. Ground improvement techniques will be employed during construction which could alter the characteristics of the soil prior to excavation.

6.7.1.3 Charles Street Alternative

If selected as the preferred alternative, the volume of soils that would be excavated during construction of the Charles Street Alignment Alternative is estimated to be 67,200 cubic yards in

addition to those associated with the Core Tunnel Segment. This estimate includes soils that would be excavated to accommodate the Charles Street tunnel, the segment of this alternative beneath Elliot Norton Park, and the boat section. Approximately 8,300 cubic yards of this soil would be fill.

6.7.1.4 Stuart Street Alternative

It is estimated that there would be 99,549 cubic yards of soils excavated, in addition to those associated with the Core Tunnel Segment, to accommodate construction of the proposed Stuart Street alternative. Approximately 59,800 cubic yards of this material would be fill, including concrete, brick, and steel debris from demolition of the abandoned Green Line tunnel.

6.7.1.5 Columbus Avenue Alternative

It is estimated that there would be 51,100 cubic yards of soils excavated, in addition to those associated with the Core Tunnel Segment, to accommodate construction of the proposed Columbus Avenue alternative. Approximately 25,900 cubic yards of this material would be fill.

6.7.2 Contaminated Soils

The Massachusetts Department of Environmental Protection Bureau of Waste Site Cleanup (MADEP-BWSC) records were reviewed for sites within one block of the Core Tunnel Segment and alternative alignments. A number of locations are identified in the MADEP-BWSC records where releases of oil and other hazardous materials have been reported in the project vicinity. Information about these sites is presented in Technical Appendix E.

Chemical characterization testing will be performed in conjunction with geotechnical testing along the preferred alignment when it is selected. For this reason, comprehensive analytical data of soils within the Core Tunnel Segment and proposed alternative alignments are not currently available, but it is assumed that some percentage of fill material will be contaminated with petroleum and metals. It is assumed that the fill material excavated during construction of the project will probably not be suitable for backfill or reuse because it may not meet physical specifications or may contain oil or hazardous materials that would require response actions in accordance with the Massachusetts Contingency Plan. Glacial till and marine clay material is assumed to be uncontaminated, but will probably not be suitable for backfill because it may not meet required material specifications. However, the till and clay will probably be suitable for reuse or recycling.

6.7.3 Excavate Disposal Options

A Soil Management and Disposal Plan will be developed for the Silver Line Phase III project. It will be designed to minimize costs and potential liability by assuring proper and adequate soil management, while satisfying all relevant regulations and policies. The plan will be prepared in coordination with the Construction Management Plan and the Transportation Management Plan in order to identify appropriate truck routes for delivery of materials and removal of excavate. A general condition of the truck routing is to minimize any truck traffic in front of NEMC along Washington Street between Kneeland Street and the proposed portal location, should any of the NEMC portal Build Alternatives be selected. (See Section 6.10 for additional discussion of traffic.) Determination of the optimal reuse, recycle or disposal options under this plan will generally be made once final characterization of soils is obtained along the preferred alternative alignment. Management of soils generated by excavation during the Silver Line Phase III project involves consideration of chemical characterization; determination of suitability for reuse, recycle, and disposal; stockpiling; and transport of the materials.

The evaluation of the soil management options for the Silver Line Phase III project excavation materials will be designed to protect human health and the environment. Selected management

options are based on MCP risk based cleanup criteria and the guidance and evaluation criteria presented in the following DEP policies:

- Reuse and Disposal of Contaminated Soils at Massachusetts Landfills, Policy No. COMM-97-001.
- Interim Remediation Waste Management Policy for Petroleum Contaminated Soils, Policy No. WSC-94-400.

The policies and guidance cited above recommend the consideration of reuse and recycling options over disposal and treatment options whenever possible. The policies allow for the consideration of cost where management options are judged to be of similar risk to human health and the environment. Considerations associated with reuse, recycling, and landfill disposal of the excavated soils are discussed below.

6.7.3.1 Reuse Options

Options for reuse of soils excavated during construction of the Silver Line Phase III project include reuse as construction or other backfill; reuse as cover and/or grading material at licensed operating lined Massachusetts landfills; reuse as cover or grading/contouring materials at unlined Massachusetts municipal landfills subject to closure and capping; and reuse as fill or cover at Brownfields sites.

6.7.3.2 Recycling Options

Recycling options for Silver Line Phase III excavated soils include off-site processing at Massachusetts-permitted asphalt plants or at out-of-state asphalt batching plants.

Recycling of Silver Line Phase III excavation soils at DEP licensed Massachusetts recycling facilities is considered a viable option, but would be costly relative to construction site backfilling primarily because this option would incur transportation costs and facility fees, and it could require supplemental characterization of the soils.

6.7.3.3 Landfill Disposal Options

The available landfill disposal options for Silver Line Phase III excavation soils include disposal of such soils at licensed operating Massachusetts landfills; disposal at licensed out-of-state landfills; and disposal at licensed out-of-state hazardous waste landfills.

Landfill disposal of Silver Line Phase III excavated soil materials is the least favored option under the current regulatory environment. DEP's solid waste management hierarchy, established in DEP's Solid Waste Master Plan, prefers that contaminated soil not be disposed at landfills if feasible alternatives exist that involve the reuse, recycling, destruction, and/or detoxification of such materials, with cost not serving as the sole determinant of feasibility/unfeasibility. However, certain excavation materials, due to their physical qualities (e.g., clay) may not be suitable for reuse as daily cover at lined or unlined landfills. Disposal of contaminated soils at lined or unlined landfills requires approval from the Massachusetts Department of Environmental Protection-Department of Solid Waste Management (MADEP-DSWM).

If disposal at licensed state landfills is not possible due to lack of DEP approval or available capacity, then excavate materials may be disposed at an out-of-state licensed lined landfill. Soils that meet the acceptance criteria can be transported to a lined landfill in New Hampshire.

The final landfill option is for soils that are characterized as hazardous waste. This material may be disposed at an out of state licensed Hazardous Waste Landfill.

6.8 Construction Dewatering

As described in the Section 5.8, temporary dewatering and groundwater control will be necessary during construction to reduce the volume of water at the face of mined tunnel sections and to maintain a dry excavation in the cut-and-cover sections between slurry walls.

Effluent from construction dewatering activities would be treated onsite and then discharged to the Boston Water and Sewer Commission's (BWSC) storm or combined sewer drains. The United States Environmental Protection Agency (U.S. EPA) and the BWSC have been consulted regarding potential permitting requirements associated with these dewatering activities during construction of the Silver Line Phase III Project. The Boston Groundwater Trust has also been consulted during the planning process of the project and will continue to be consulted throughout design and construction.

This section presents a discussion of the dewatering methodology that will be utilized for the project, a discussion of water quality considerations associated with dewatering activities, and a discussion of the potential U.S. EPA and BWSC permitting requirements that could be associated with project dewatering activities.

6.8.1 Construction Dewatering Methodology

For the mined sections of the tunnel, groundwater control will be provided from the implementation of ground stabilization methods such as permeation grouting and jet grouting. These methods involve strengthening the soil in the area of the tunnel by injecting chemical (typically silicate) or cement grout into the soil in advance of excavating the tunnel face. The grouting treatment produces a soil mass at the tunnel face that is relatively impermeable. The goal is to limit ground water inflows at the tunnel face during mining to less than 25 gallons per minute. This inflow could be collected and removed via pumping.

For the cut-and-cover sections of tunnel being constructed inside slurry walls, the slurry walls will extend to and form a barrier that encloses the excavation and reduces the potential for groundwater to enter through the sidewalls of the excavation. The bottom of the excavation will be in clay, which is relatively impermeable. Any groundwater that does enter the excavation will be removed by pumping. The estimated groundwater pumping is less than 50 gallons per minute at any one heading.

In areas where there are buildings supported on timber piles, groundwater observation wells will be installed to monitor groundwater levels. Well locations will be selected in consultation with the Boston Groundwater Trust. Well levels will be measured monthly for one year before construction and during construction. Data will be shared with the Boston Groundwater Trust monthly, and the Trust will be given access to the wells to make their own measurements. After construction, the wells will be turned over to the Trust.

Prior to construction, the criteria will be established for the allowable temporary lowering of groundwater levels. These levels will be based on the locations of abutting structures that could be affected by a lower groundwater level as well as the individual characteristics of the buildings. Prior to commencing the work, a mitigation plan will be developed to detail the specific steps to adequately undertake the work, including corrective measures in the event that construction causes the groundwater to fall below the specified levels to avoid impacts on abutting structures.

Before, during, and after construction, groundwater levels in observation wells will be monitored on a regular basis to determine if construction activities are affecting groundwater levels. Mitigation measures may include grouting or other ground treatment to cut off groundwater flow, working in smaller areas at any one time, reducing groundwater pumping rates, and groundwater recharge.

6.8.2 Water Quality

Geotechnical investigations conducted for this project have shown that groundwater in the Silver Line Phase III project area is divided into two aquifers: an unconfined aquifer in the fill and a confined aquifer in the glacial till and fractured bedrock. During construction, groundwater control will be necessary to maintain dry excavations in cut-and-cover sections and to maintain face stability in tunneled sections.

Wastewater from construction dewatering activities can contain contaminants such as petroleum hydrocarbons, suspended solids, and metals. It can also have a high pH (high alkalinity) from the soil stabilization. Effluent monitoring, and limits on the quantitative levels of these parameters and other constituents of the effluent stream are typically established under the terms of BWSC and NPDES permits (discussed below).

6.8.3 Permitting

Dewatering discharges to the BWSC stormwater drainage system would require both a Construction Dewatering National Pollutant Discharge Elimination System (NPDES) Permit from U.S. EPA and a Dewatering Discharge Permit from BWSC. Discharges to a BWSC combined sewer would require a Dewatering Discharge Permit from BWSC and a Sewer Use Discharge Permit from the Massachusetts Water Resources Authority (MWRA). U.S. EPA has confirmed that discharges exclusively to the BWSC combined system would not require a NPDES permit.

U.S. EPA indicated during consultations for this project that a general permit for construction dewatering is currently under development, but will probably not be promulgated for about four years.[3] U.S. EPA indicated its willingness to modify the existing Silver Line Phase II (Transitway) permit as a way of providing construction dewatering NPDES coverage for the Phase III Project if such coverage is required. Alternatively, if coverage under the upcoming general permit is available at the right time, it is reasonable to anticipate that this might be a more streamlined approach to NPDES permitting for the Project.

U.S. EPA has indicated that its primary pollutant of concern with recent NPDES permits issued for projects in Boston (particularly the CA/T Project) has been total suspended solids (TSS). Accordingly, TSS monitoring and mitigation would likely be the most significant feature of a construction dewatering NPDES permit for Phase III of the Silver Line. Monitoring and mitigation for aluminum would also be required by U.S. EPA due to the anticipated use of grout to stabilize tunnel walls as the project progresses.

BWSC's Dewatering Discharge Permit application is brief and BWSC has indicated that obtaining the permit is typically a short process (perhaps two weeks).[4] It is expected that the MWRA Sewer Use Discharge Permit process will require a similar level of effort and time. The BWSC application requires submission of several documents, including a Site Plan showing the source(s) of discharge and copies of the MWRA or NPDES permits for the project. Plans and commitments to mitigation for pollutants, especially TSS, must be described in the application. Onsite mitigation, such as settling tanks and effluent monitoring, must be sufficient to prevent introduction of pollutants into the BWSC sewer system.

A stormwater NPDES permit would also be required because the project would include more than one acre of open construction, which will collect precipitation during rain events. Appropriate measures to limit the amount of precipitation entering open areas would be required under this general permit, which would also contain requirements for appropriate Best Management Practices (BMPs) to assure that stockpiles of excavate materials would be properly stored to

[3] U.S. EPA Meeting with Russ Wilder and Sam Moffett of URS Corporation and Roger Jansen, Brian Pitt, and Steven Rapp of USEPA, May 12, 2004

[4] Telephone conversation between Sam Moffett of URS Corporation and John Sullivan of Boston Water and Sewer Commission, May 19, 2004.

prevent runoff of these materials into storm drains during storm events. The contractor would be required to prepare and execute a Storm Water Pollution Prevention Plan in accordance with the NPDES General Permit. U.S. EPA has indicated that the project may be eligible for NPDES stormwater coverage under the existing Stormwater General Permit. It should be noted that activities covered under the Stormwater General Permit would not extend to post-construction operational discharges. Thus, discharges associated with sumps in the completed Phase III tunnel would need separate NPDES coverage, although U.S. EPA has indicated that proposed regulations could change this.

6.9 Noise and Vibration

This section discusses the potential noise and vibration impacts associated with the construction activities for each of the Silver Line Phase III Build Alternatives. Impact minimization and mitigation measures are also discussed. Additional information on the noise and vibration data collection and analysis is presented in the Noise and Vibration Technical Report included as Technical Appendix C.

Noise and vibration related to construction would result from the operation of heavy equipment needed to construct tunnels, stations, walls, and travel ways for the project. Additionally, noise from demolition activities associated with the construction would result in construction period noise and vibration. Noise and vibration produced by construction equipment working on this project would occur with varying intensity and duration during the various phases of construction. Overall project construction is estimated to range from four to six years. Because of the different phases of construction and the large project area, no single location would experience construction noise or vibration for the entire duration of the project.

6.9.1 Noise Impact Criteria

The FTA does not specify standardized construction noise impact criteria, but does provide what it refers to as “reasonable guidelines”, in the absence of, or in conjunction with, local noise impact criteria. Table 6.9-1 below lists these guidelines. Daytime is defined as 7:00 a.m. to 9:59 p.m. and nighttime is defined as 10:00 p.m. to 6:59 a.m.

Table 6.9-1 – Prescriptive FTA Construction Noise Impact Guidelines

Land Use	One-Hour L_{eq} (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FTA, 1995

Each noise-sensitive receptor was assigned to one of the following FTA Construction Noise Categories: Residential, Commercial, or Industrial. Although the FTA method has no Institutional category for analysis of construction noise, a generalized land use survey indicated a number of institutional receptors, including churches, theaters, and university classrooms. For the FTA construction noise impact analysis, each of these buildings was analyzed using either the Residential or Commercial criteria. The Residential criterion was applied to those receptors where the primary activities included quiet thought, discussion, or contemplation, or where speech intelligibility was important, such as theaters and classrooms. The Commercial criterion was applied to receptors where physical activity or social interaction were the primary activities, such as gyms, parks, churches, and community centers.

The City of Boston's Regulations for the Control of Noise in the City of Boston (Regulations) addresses noise from construction activities in its Regulation 3 presented in Table 6.9-2. The regulation lists noise limits in terms of L_{10} (the noise level exceeded 10 percent of the time) and Maximum Noise Levels (L_{max}) for construction noise at the lot line of the affected property (or a distance of 50 feet, whichever is greater).

Table 6.9-2 – City of Boston Noise Restrictions for Construction Activities*

Receptor Category of Affected Property	L_{10} Level (dBA)	Maximum Noise Level (dBA)
Residential or Institutional	75	86
Business or Recreational	80	n/a
Industrial	85	n/a

* At affected property lot line or a distance of 50 feet, whichever is greater.
Source: City of Boston, Regulation 3, Section 3.1, 2004.

Noise from impact-type construction devices are specifically exempted from these noise limits, as specified in Section 3.4 of the Regulations. No impact-type construction devices are anticipated to be used for this project. The L_{10} noise limits are statistical levels most suitable for directly measuring on-site noise to ensure compliance, or if detailed information of specific equipment and duty cycles is available. At the present time, construction has not commenced and detailed construction equipment information has not yet been formulated; thus, L_{10} noise limits cannot be predicted for this construction analysis. Rather, for the construction analysis the L_{max} limit of 86 dBA at residential land uses (or at 50 feet from the construction activity, whichever is greater) will be utilized to assess noise impact. Additionally, the energy-average noise levels (which use the L_{eq} metric) from construction activities will be compared with the prescriptive standards recommended in the FTA guidance listed in Table 6.9-1.

The FTA procedure for a general construction noise assessment was utilized for this analysis. The general assessment estimates the combined noise level in one hour (i.e., $L_{eq}(h)$) from the operation of one piece of construction equipment at one or more construction and staging areas. Therefore, the results for noise impacts from construction activities represent a conservative estimate based on the assumptions used in the model.

6.9.2 Vibration Impact Criteria

The FTA has also developed criteria for assessing potential vibration impacts related to the construction of transit projects. The criteria contained in the FTA Manual are based on community reaction to transit-related vibration and the potential for adverse effects on vibration-sensitive activities and processes. The criteria identify intensities of ground-borne vibration and noise that may be considered significant and, thus, require consideration of mitigation and abatement measures.

The FTA assigns sensitive land uses to the following three categories:

Vibration Category 1: High Sensitivity - Buildings where low ambient vibration is essential for operations within the building. Actual vibration levels may be below the level of human perception.

Vibration Category 2: Residential - Residences and buildings where people normally sleep. This includes private dwellings, hospitals and hotels where nighttime sensitivity is assumed to be of utmost importance.

Vibration Category 3: Institutional - Land uses with primarily daytime use including schools, churches, other institutions and quiet offices that do not have vibration-sensitive equipment.

The New England Medical Center and Benjamin Franklin Smith Printers were the only receptors in vibration category 1.

Impact criteria are also given for certain types of buildings whose use does not fit into any of the three vibration categories:

Vibration Category 4: Performance and production facilities containing sensitive equipment, such as concert halls, television studios and music recording studios.

Vibration Category 5: Public auditoriums and mixed-use performance facilities.

Vibration Category 6: Theatres and other dramatic performance spaces.

Table 6.9-3 contains the FTA criteria used to determine noise and vibration impacts from construction activities for this project. Where vibration is intermittent (e.g., transit train pass-bys) human annoyance from ground vibration and noise is somewhat dependent on the number of vibration events that occur during a typical 24-hour period. The FTA Manual defines two groups of event frequency – "Frequent" and "Infrequent". "Frequent" is defined as 70 or more vibration events per day while "infrequent" is defined as less than 70 events per day. The impact thresholds for frequent and infrequent events are summarized in Table 6.9-4. The frequency of events is not relevant to land use categories 1 and 4.

Table 6.9-3 – Criteria for Impact for Human Annoyance and Interference due to Ground-Borne Vibration and Ground-Borne Noise**

Receptor Category	Category Description	Ground-borne Vibration (VdB re 1 micro in/sec)		Ground-borne Noise (dBA re 20 micro Pa)	
		Events*			
		Frequent	Infrequent	Frequent	Infrequent
1	Low interior ambient is essential	65	65	n/a	n/a
2	Residential & sleep	72	80	35	43
3	Institutional & daytime	75	83	40	48
4	Concert hall, TV/Recording Studio **	65	65	25	25
5	Auditorium **	72	80	30	38
6	Theatre **	72	80	35	43

* Frequent is defined as equal to or greater than 70 events per day
** If the building is occupied during transit/construction events
See section 12.2.2 of FTA Manual re potential for structural damage to fragile structures
Source: FTA, 1995, Table 8.1

If these criteria are exceeded, feasible/effective vibration mitigation measures will need to be considered. If feasible/effective mitigation actions were not available, then unavoidable adverse impacts would occur.

As the Silver Line Phase III project may affect old, fragile[5] buildings of historical significance, damage to these building is possible (but not necessarily probable) if ground vibration levels exceed the following criteria:

- 0.20 in/sec peak particle velocity (approximately 100 VdB) for fragile buildings and
- 0.12 in/sec peak particle velocity (approximately 95 VdB) for extremely fragile buildings.

The FTA procedure for a general construction vibration assessment was utilized for this analysis. The general assessment estimates the anticipated ground-borne vibration and noise from the continuous operation of one piece of construction equipment at one or more construction and staging areas. Therefore, the results for vibration impacts from construction activities represent a conservative estimate based on the assumptions used in the model.

Three types of construction sites were identified for this analysis: tunnels, staging areas, and cut-and-cover excavation areas. For each construction site, it was assumed that the equipment would be operating at full power for 80 percent of the time during the day (7:00 AM to 9:59 PM) and 40 percent of the time at night (10:00 PM to 6:59 AM.). For the tunnel areas, no noise propagation to surface receptors was assumed. For the staging areas, the construction equipment would consist of loaded trucks. For the cut-and-cover excavation areas, the construction equipment would consist of hydromills, trucks and small bulldozers. A hydraulic hammer or hoe ram would be used to demolish the existing abandoned Green Line tunnel within the Tremont Street right-of-way (Tremont Street and Stuart Street Alternatives, and a short section for the Charles Street Alternative) and for tunnel demolition at Essex Street and Atlantic Avenue to connect with the existing Silver Line Phase II tunnel. These machines would typically be used in the excavated hole after decking is in place. One piece of equipment was assumed to be operating at any one time for each construction area. No topography or ground effects were included as the project area is primarily flat; however, the cut-and-cover excavation areas were analyzed with and without decking. It was assumed decking would provide 20 dBA of noise level reduction relative to no decking[6].

Table 6.9-4 presents the noise and vibration emission levels for each piece of construction equipment being contemplated for use. The daytime and nighttime hourly usage factors were 0.8 and 0.4, respectively.

[5] Buildings were designated Not Fragile, Fragile, or Extremely Fragile based on a survey by structural engineers of their material, method of construction, and condition of structural and cosmetic components. Buildings that have neither compromised structural components nor delicate finishes were designated as Not Fragile. Buildings with robust structures, but which have delicate or intricate cosmetic components were designated as Fragile. Extremely Fragile buildings were those that were known to have sensitive or compromised load-bearing components. Historic status is not directly considered when determining fragility, but age may be considered implicitly via the other properties. 17 buildings in the project area were designated as Fragile; there were no buildings designated as Extremely Fragile.

[6] Decking noise reduction would not apply to the operation of the hydromill since it is only used to support cut-and-cover construction prior to installing decking.

Table 6.9-4 – Noise and Vibration Emission Levels for Relevant Construction Equipment

		Vibration (1)		Noise	
Equipment Description	**Construction Area**	**Peak Particle Velocity at 25 ft (in/sec)**	**Approximate Lv at 25 ft (rms VdB re 1 microinch/sec**	**Approximate L_{max} at 50 ft (dBA)**	**Data Source**
Hydromill (slurry wall ex) in soil	cut-and-cover	0.008	66	82	(2)
Caisson drilling*	tunnel	0.089	87	n/a	n/a
Loaded trucks (dump trucks & concrete trucks)	staging, cut-and-cover	0.076	86	88	(1)
Hoe Ram (3)	demolition	0.420	100	90	(2)
Bulldozer, small	cut-and-cover	0.003	58	85	(1)

1. Source: FTA, 1995 except Hoe Ram (see Note 3).
2. Source: URS/DMJM+HARRIS Joint Venture, 2004.
3. Hoe Ram: Draft EIS, SR 99: Alaskan Way Viaduct & Seawall Replacement Project, Noise and Vibration Discipline Report, March 2004, p. 71, upper range (0.42 PPV (in/sec)).

* Surrogate for tunnel mining equipment.

6.9.3 Construction Period Noise Impacts

Potential noise impacts from construction of Silver Line Phase III were assessed as described above and summarized below. The construction noise impacts for the Build Alternatives are summarized in Tables 6.9-5 through 6.9-9. These tables show the total number of noise impacts by land use, using both the FTA and the City of Boston noise impact standards for both daytime and nighttime activities. The summary discussion also presents the number of dwellings impacted by construction noise[7]. A detailed discussion on the analysis and listing of specific sites impacted by construction noise can be found in the Noise and Vibration Technical Report, included as Technical Appendix C. For areas of the alignments where cut-and-cover construction methods would be used, construction activity noise levels were analyzed both before and after the installation of decking.

Core Tunnel Segment

As shown in Table 6.9-5 below, prior to the installation of temporary concrete decking 20 sites (including approximately 1497 individual dwelling units) adjacent to the Core Tunnel Segment would be impacted by one or more of the anticipated construction activities during daytime hours (7 a.m. to 10 p.m.), while 11 sites (including approximately 1610 individual dwelling units) would be impacted if construction occurred during nighttime hours (10 p.m. to 7 a.m.). After the installation of decking, none of the sites adjacent to the alignment would be impacted by anticipated construction activities during daytime hours, and one site (including approximately 750 individual dwelling units) would be impacted if construction occurred during nighttime hours. The City of Boston noise regulation is predicted to be exceeded at 12 residential or institutional sites before decking is able to be installed and at none of the sites after decking is installed.

[7] The total number of dwellings includes total hotel rooms, residences, and the number of individual students that would be housed in college dormitory regardless of their location relative to the construction activity. The tabulation also assumes that all dwelling units will be occupied throughout the duration of construction. Therefore, this represents the most conservative estimate.

Table 6.9-5 – Summary of Predicted Construction Noise Impacts: Core Tunnel Segment

Site Name	FTA Receptor Category*	FTA Construction Noise Impacts			
		Before Decking		After Decking	
		Daytime	Nighttime	Daytime	Nighttime
The Apartments at 40 Boylston St	Residential		✓		
Chauncy House / New England Textile	Residential		✓		
Boylston Place Condo	Residential	✓	✓		
Colonial Building/Colonial Theatre	Residential	✓	✓		
Emerson College – Little Bldg	Residential	✓	✓		✓
St. Francis House	Residential	✓	✓		
The Apartments at 40 Boylston St	Residential	✓	✓		
Millennium Place / Ritz Carlton Hotel & Towers	Residential	✓	✓		
11 Essex Street	Residential	✓	✓		
15-23 Essex Street	Residential	✓	✓		
Hong Lok House	Residential	✓	✓		
Boston Common	Commercial	✓			
Boylston Place	Commercial	✓			
Troquet Bistro	Commercial	✓			
Commonwealth Books	Commercial	✓			
Emerson College: Walker Building	Commercial	✓			
China Trade Center	Commercial	✓			
Washington-Essex Building	Commercial	✓			
Liberty Tree Building	Commercial	✓			
Club Hollywood	Commercial	✓			
Lincoln Plaza west	Commercial	✓			
Financial Place (former Plymouth Rock building)	Commercial	✓			
TOTAL IMPACTS		**20**	**11**	**0**	**1**

* The FTA has no construction noise criterion for Institutional receptors; institutional land uses were assigned to either the Residential or Commercial receptor category using the criteria given in Section 6.9.1.

Tremont Street Alignment

As shown in 6.9-6 below, prior to the installation of temporary concrete decking 17 sites (including approximately 2090 individual dwelling units) adjacent to the Tremont Street Alignment would be impacted by one or more of the anticipated construction activities during both daytime and nighttime hours. After the installation of decking, none of the sites adjacent to the alignment would be impacted by anticipated construction activities during daytime hours and seven sites (including approximately 876 individual dwelling units) would be impacted if construction occurred during nighttime hours. The City of Boston noise regulation is predicted to be exceeded at 16 residential or institutional sites before decking is able to be installed and at none of the sites after decking is installed.

Table 6.9-6 – Summary of Predicted Construction Noise Impacts: Tremont Street Alignment

Site Name	FTA Receptor Category*	FTA Construction Noise Impacts			
		Before Decking		After Decking	
		Daytime	Nighttime	Daytime	Nighttime
Hotel Touraine	Residential	✓	✓		✓
Emerson College – Little Building	Residential	✓	✓		✓
Emerson College – Majestic Theatre	Residential	✓	✓		✓
Emerson College: former Union Savings Bank Building	Residential	✓	✓		✓
Fathers New Tamworth CF Inc (222 Tremont Street)	Residential	✓	✓		✓
Apartments at 224 Tremont Street	Residential	✓	✓		✓
Apartments at 226 Tremont Street	Residential	✓	✓		✓
Charlie Flynns (228 Tremont Street)	Commercial	✓			
Apartments at 230 Tremont Street	Residential	✓	✓		
Shanghai Restaurant	Commercial	✓			
Future Loews Boston Hotel	Residential	✓	✓		
Wilbur Theater	Residential	✓	✓		
Wang Theater	Residential	✓	✓		
Shubert Theater	Residential	✓	✓		
Tremont Boston Courtyard Marriott	Residential	✓	✓		
South Cove Plaza East	Residential	✓	✓		
NEMC west building	Residential		✓		
Doubletree Hotel	Residential	✓	✓		
NEMC east building	Residential		✓		
TOTAL IMPACTS		**17**	**17**	**0**	**7**

* The FTA has no construction noise criterion for Institutional receptors; institutional land uses were assigned to either the Residential or Commercial receptor category using the criteria given in Section 6.9.1.

Charles Street Alignment

As shown in Table 6.9-7 below, prior to the installation of temporary concrete decking four (4) sites (including approximately 503 individual dwelling units) adjacent to the Charles Street Alignment would be impacted by one or more of the anticipated construction activities during daytime hours and five sites (including approximately 503 individual dwelling units) would be impacted if construction occurred during nighttime hours. After the installation of decking, none of the sites adjacent to the alignment would be impacted by anticipated construction activities during daytime or nighttime hours. The City of Boston noise regulation is predicted to be exceeded at six (6) residential or institutional sites before decking is able to be installed and at none of the sites after decking is installed.

Table 6.9-7 – Summary of Predicted Construction Noise: Charles Street Alignment

Site Name	FTA Receptor Category*	FTA Construction Noise Impacts			
		Before Decking		After Decking	
		Daytime	Nighttime	Daytime	Nighttime
Elliot Norton Park	Commercial	✓			
Lyndeboro Place Townhouses	Residential	✓	✓		
South Cove Plaza East	Residential	✓	✓		
NEMC west building	Residential		✓		
Doubletree Hotel	Residential	✓	✓		
NEMC east building	Residential		✓		
TOTAL IMPACTS		**4**	**5**	**0**	**0**

* The FTA has no construction noise criterion for Institutional receptors; institutional land uses were assigned to either the Residential or Commercial receptor category using the criteria given in Section 6.9.1.

Stuart Street Alignment

As shown in Table 6.9-8 below, prior to the installation of temporary concrete decking six (6) sites (including approximately 820 individual dwelling units) adjacent to the Stuart Street Alignment would be impacted by one or more of the anticipated construction activities during daytime hours and eight sites (including approximately 820 individual dwelling units) would be impacted if construction occurred during nighttime hours. After the installation of decking, none of the sites adjacent to the alignment would be impacted by anticipated construction activities during daytime or nighttime hours. The City of Boston noise regulation is predicted to be exceeded at seven residential or institutional sites before decking is able to be installed and at none of the sites after decking is installed.

Table 6.9-8 – Summary of Predicted Construction Noise Impacts: Stuart Street Alignment

Site Name	FTA Receptor Category*	FTA Construction Noise Impacts			
		Before Decking		After Decking	
		Daytime	Nighttime	Daytime	Nighttime
Wilbur Theater	Residential	✓	✓		
Wang Theater	Residential	✓	✓		
Shubert Theater	Residential	✓	✓		
Tremont Boston Courtyard Marriott	Residential	✓	✓		
South Cove Plaza East	Residential	✓	✓		
NEMC west building	Residential		✓		
Doubletree Hotel	Residential	✓	✓		
NEMC east building	Residential		✓		
TOTAL IMPACTS		**6**	**8**	**0**	**0**

* The FTA has no construction noise criterion for Institutional receptors; institutional land uses were assigned to either the Residential or Commercial receptor category using the criteria given in Section 6.9.1.

Columbus Avenue Alignment

As shown in Table 6.9-9 below, prior to the installation of temporary concrete decking three sites (including approximately 950 individual dwelling units) adjacent to the Columbus Avenue Alignment would be impacted by one or more of the anticipated construction activities during daytime hours, while four (4) sites (including approximately 960 individual dwelling units) would

be impacted if construction occurred during nighttime hours. After the installation of decking, none of the sites adjacent to the alignment would be impacted by anticipated construction activities during daytime hours or during nighttime hours. The City of Boston noise regulation is predicted to be exceeded at three (3) residential or institutional sites before decking is able to be installed and at none of the sites after decking is installed.

Table 6.9-9 – Summary of Predicted Construction Noise Impacts: Columbus Avenue Alignment

Site Name	FTA Receptor Category*	FTA Construction Noise Impacts			
		Before Decking		After Decking	
		Daytime	Nighttime	Daytime	Nighttime
The Boston Park Plaza Hotel	Residential	✓	✓		
South Cove Plaza	Residential		✓		
Boston Renaissance Charter School	Residential		✓		
VGA Pizza	Commercial	✓			
Flash's Cocktails	Commercial	✓			
Fire Station	Residential		✓		
TOTAL IMPACTS		**3**	**4**	**0**	**0**

* The FTA has no construction noise criterion for Institutional receptors; institutional land uses were assigned to either the Residential or Commercial receptor category using the criteria given in Section 6.9.1.

Construction Staging Areas

Potential noise impacts from activities at construction staging areas were analyzed as described above and are summarized in Table 6.9-10. Please note that the final selection of the potential staging areas has not yet been made. Not all of the staging areas listed would actually be used; rather, these are the sites being considered for use as staging areas. Thus, the "Total" tabulation of predicted adjacent land use impacts for each alignment alternative should be considered a conservative, worst-case estimate of potential noise impacts.

Table 6.9-10 indicates that with the Core Tunnel Segment, a maximum of 24 adjacent land uses (8 residential or institutional and nine business or recreational) would experience noise levels corresponding to "impact" as defined by the FTA daytime noise standard. During nighttime construction, 39 land uses would exceed FTA standards for nighttime noise levels from construction activities. The Core Tunnel Segment staging areas are predicted to result in a maximum of 23 adjacent land uses experiencing noise impacts under the City of Boston construction noise standard.

Construction staging areas for the Tremont Street alignment would result in a maximum of 18 adjacent land use impacts under the FTA daytime noise standard, and 32 impacts under the nighttime noise standard. The Tremont Street alignment sites would have a maximum of 16 adjacent land use impacts under the City of Boston construction noise standard.

Construction staging areas for the Stuart Street alignment would result in a maximum of 18 adjacent land use impacts under the FTA daytime noise standard, and 32 impacts under the nighttime noise standard. The Stuart Street alignment sites would have a maximum of 16 adjacent land use impacts under the City of Boston construction noise standard.

Table 6.9-10 – Summary of Predicted Construction Noise Impacts for Staging Areas

	FTA Daytime Construction Noise Standard			FTA Nighttime Construction Noise Standard (1)			Boston Construction Noise Standard	
Staging Area	**Residential**	**Commercial**	**Industrial**	**Residential**	**Commercial**	**Industrial**	**Residential**	**Institutional**
Core Tunnel Segment								
1	0	1	0	1	1	0	1	0
2	0	1	0	0	1	0	0	0
3	1	0	0	1	0	0	1	0
4	2	2	0	3	2	0	2	0
5	0	0	0	0	0	0	0	0
6	2	1	0	4	1	0	4	0
7	0	0	0	2	0	0	1	0
8	2	1	0	6	1	0	3	1
9	6	1	0	7	1	0	5	1
10	0	1	0	1	1	0	0	0
11	1	1	0	4	1	0	1	2
19	0	1	0	0	1	0	0	1
Total	**14**	**10**	**0**	**29**	**10**	**0**	**18**	**5**
Tremont Street Alignment								
8	2	1	0	6	1	0	3	1
9	6	1	0	7	1	0	5	1
10	0	1	0	1	1	0	0	0
11	1	1	0	4	1	0	1	2
12	1	1	0	4	1	0	0	1
13	2	1	0	4	1	0	2	0
Total	**12**	**6**	**0**	**26**	**6**	**0**	**11**	**5**
Charles Street Alignment								
8	2	1	0	6	1	0	3	1
9	6	1	0	7	1	0	5	1
10	0	1	0	1	1	0	0	0
11	1	1	0	4	1	0	1	2
12	1	1	0	4	1	0	0	1
13	2	1	0	4	1	0	2	0
14	2	1	0	6	1	0	3	2
Total	**14**	**7**	**0**	**32**	**7**	**0**	**14**	**7**

	FTA Daytime Construction Noise Standard			FTA Nighttime Construction Noise Standard (1)			Boston Construction Noise Standard	
Staging Area	**Residential**	**Commercial**	**Industrial**	**Residential**	**Commercial**	**Industrial**	**Residential**	**Institutional**
Stuart Street Alignment								
8	2	1	0	6	1	0	3	1
9	6	1	0	7	1	0	5	1
10	0	1	0	1	1	0	0	0
11	1	1	0	4	1	0	1	2
12	1	1	0	4	1	0	0	1
13	2	1	0	4	1	0	2	0
Total	**12**	**6**	**0**	**26**	**6**	**0**	**11**	**5**
Columbus Avenue Alignment								
8	2	1	0	6	1	0	3	1
9	6	1	0	7	1	0	5	1
10	0	1	0	1	1	0	0	0
11	1	1	0	4	1	0	1	2
15	0	0	0	1	0	0	0	0
16	0	1	0	0	1	0	0	0
17	0	2	0	0	2	0	0	0
18	3	0	0	3	0	0	3	0
Total	**12**	**7**	**0**	**22**	**7**	**0**	**12**	**4**

Notes:
(1) – The impacts from construction staging area represent a worst case scenario which assumes that equipment is operating at full power for 80 percent of the time during the day and 40 percent of the time during the night, and that all possible staging areas are used.

Staging areas supporting the construction of the Charles Street alignment would result in a maximum of 21 adjacent land use impacts under the FTA daytime noise standard, and 39 impacts under the nighttime noise standard. The Charles Street alignment sites would have a maximum of 21 adjacent land use impacts under the City of Boston construction noise standard.

Construction staging areas for the Columbus Avenue alignment would result in a maximum of 19 adjacent land use impacts under the FTA daytime noise standard, and 29 impacts under the nighttime noise standard. The Columbus Avenue alignment would have a maximum of 16 adjacent land use impacts under the City of Boston construction noise standard.

6.9.4 Construction Period Noise Mitigation

Potential construction noise mitigation measures may include limiting the hours of noisy construction activities to daytime hours near residences and other sensitive receptors such as hotels and hospitals. Other measures could include limiting the number of construction equipment operating at any one time. Following are additional construction noise mitigation measures that would be followed, to the extent feasible:

1. Demolition activities near South Station (Atlantic and Essex Avenues) and at the abandoned Green Line subway tunnel (at Tremont Street) shall be limited to the hours of 7:00 am to 6:00 p.m. This limitation of hours of construction activity may not be necessary if this work is conducted under decking.
2. Removal of excavate from tunneling operations offsite via heavy trucks shall be limited to the hours of 7:00 am to 6:00 p.m., to the extent practicable.
3. All noise-producing project equipment and vehicles using internal combustion engines shall be equipped with mufflers, air-inlet silencers where appropriate, and any other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. Mobile or fixed "package" equipment (e.g., arc-welders, air compressors) shall be equipped with shrouds and noise control features that are readily available for that type of equipment.
4. All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity.
5. The erection of temporary soundwall barriers will be considered where project activity is unavoidably close to noise-sensitive receptors (i.e., at the townhouses immediately north of Elliott Norton Park).
6. Electrically-powered equipment shall be used instead of pneumatic or internal combustion powered equipment where feasible.
7. Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.
8. Construction site and haul-road speed limits shall be established and enforced during the construction period.
9. The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only.
10. No project-related public address or music system shall be audible at any adjacent receptor.
11. The on-site construction supervisor shall have the responsibility and authority to receive and resolve noise complaints. A clear appeal process to the Owner shall be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor.

12. The contractor shall develop a project noise control plan, which shall have been approved by the owner or designated noise control professional and implemented prior to commencement of any construction activity.

13. Temporary concrete decking shall be used in the areas of cut-and-cover construction in order to reduce surface level noise impacts where feasible. Temporary decking will be installed after excavation of a work zone is complete. The temporary decking will also allow vehicles to travel on the roadway while construction continues below grade.

6.9.5 Construction Period Vibration Impacts

Potential vibration impacts from construction of the various project alternatives were assessed as described in Section 6.9.1 and are summarized below. The analysis predicts the number of sites with the potential for damage[8] from vibration during construction without any mitigation.

Core Tunnel Segment

The construction vibration impacts for the Core Tunnel Segment are summarized in Table 6.9-11 which shows the total number of vibration impacts by land use. As shown below, a total of 23 sites near along the Core Tunnel Segment would be impacted by vibration during one or more of the anticipated construction activities. A total of 25 sites would be impacted by ground-borne noise (the rumbling sound caused by the vibration of room surfaces). A total of six sites near the alignment were predicted to have a potential for from vibration during construction.

Tremont Street Alignment

The construction vibration impacts for the Tremont Street Alignment are summarized in Table 6.9-12, which shows the total number of vibration impacts by land use. As shown below, a total of 19 sites near the Tremont Street Alignment would be impacted by vibration during one or more of the anticipated construction activities. A total of 16 sites near the alignment would be impacted by ground-borne noise, and a total of four sites were predicted to have a potential for damage from vibration during project construction.

Charles Street Alignment

The construction vibration impacts for the Charles Street Alignment are summarized in Table 6.9-13, which shows the total number of vibration impacts by land use. As shown below, a total of 14 sites near the Charles Street Alignment would be impacted by vibration during one or more of the anticipated construction activities. A total of 12 sites near the alignment would be impacted by groundborne noise, and one site was predicted to have a potential for damage from vibration during project construction.

Stuart Street Alignment

The construction vibration impacts for the Stuart Street Alignment are summarized in Table 6.9-14, which shows the total number of vibration impacts by land use. As shown below, a total of 17 sites near the Charles Street Alignment would be impacted by vibration during one or more of the anticipated construction activities. A total of 15 sites near the alignment would be impacted by ground-borne noise, and two sites were predicted to have a potential for damage from vibration during project construction.

Columbus Avenue Alignment

The construction vibration impacts for the Columbus Avenue Alignment are summarized in Table 6.9-15, which shows the total number of vibration impacts by land use. As shown below, four sites near the Columbus Avenue Alignment were predicted to be impacted by vibration during one or more of the anticipated construction activities. A total of four sites near the alignment

[8] The FTA Guidelines (Sect. 12.2.2) provide criteria for "damage thresholds" that indicate when cosmetic, non-structural damage may start to occur. The two criteria are 0.20 inches per second for "fragile" buildings and 0.12 inches per second for "extremely fragile historic" buildings.

would be impacted by ground-borne noise; similarly, three sites were predicted to have a potential for damage from vibration during project construction

Table 6.9-11 – Summary of Predicted Construction Vibration Impacts: Core Tunnel Segment

Site Name	FTA Receptor Category	Fragility	Vibration Impact	Ground-borne Noise Impact	Potential for Damage
Four Seasons Hotel	2	Not fragile		✓	
Boylston Place	3	Not fragile	✓	✓	
Troquet Bistro	3	Not fragile	✓	✓	
Commonwealth Books	3	Not fragile	✓	✓	
Boylston Place Condo	2	Fragile	✓	✓	✓
Emerson College – Walker Building	4	Fragile	✓	✓	✓
Colonial Building/Colonial Theater	6	Fragile	✓	✓	✓
Hotel Touraine	2	Not fragile	✓	✓	
Emerson College – Little Building	2	Fragile	✓	✓	✓
Emerson College – Ansin Building	4	Not fragile		✓	
The Apartments at 40 Boylston Street (parcel 1)	2	Not fragile	✓	✓	
St. Francis House	2	Not fragile	✓	✓	
The Apartments at 40 Boylston Street (parcel 2)	2	Not fragile	✓	✓	
Millennium Place/Ritz Carlton Hotel & Towers	2	Not fragile	✓	✓	
China Trade Center	3	Not fragile	✓	✓	
Washington-Essex Building	3	Fragile	✓	✓	✓
Liberty Tree Building	3	Fragile	✓	✓	✓
11 Essex Street	2	Not fragile	✓	✓	
15-23 Essex Street	2	Not fragile	✓	✓	
Hong Lok House	2	Not fragile	✓	✓	
Chauncy House/New England Textile	2	Not fragile	✓	✓	
Lincoln Plaza west	3	Not fragile	✓	✓	
Lincoln Plaza east	3	Not fragile	✓	✓	
One Financial Center (hoe ram only)	3	Not fragile	✓	✓	
Financial Place (former Plymouth Rock Building – includes cut-and-cover and hoe ram)	3	Not fragile	✓	✓	
TOTAL IMPACTS			**23**	**25**	**6**

Table 6.9-12 – Summary of Predicted Construction Vibration Impacts: Tremont Street Alignment

Site Name	FTA Receptor Category	Fragility	Vibration Impact	Ground-borne Noise Impact	Potential for Damage
Hotel Touraine	2	Not fragile	✓	✓	
Emerson College – Little Building	2	Fragile	✓	✓	✓
Emerson College – Cutler Majestic Theater	6	Fragile	✓	✓	✓
Emerson College – former Union Savings Bank	3	Not fragile	✓	✓	
Apartments at 222 Tremont Street	2	Not fragile	✓	✓	
Apartments at 224 Tremont Street	2	Not fragile	✓	✓	
Apartments at 226 Tremont Street	2	Not fragile	✓	✓	
Apartments at 230 Tremont Street	2	Not fragile	✓	✓	
Future Loews Boston Hotel	2	Not fragile	✓	✓	
Wilbur Theater	6	Fragile	✓	✓	✓
Wang Theater	6	Fragile	✓	✓	
Shubert Theater	6	Fragile	✓	✓	✓
Tremont Boston Courtyard by Marriott	2	Not fragile	✓	✓	
Lyndeboro Place Townhouses	2	Fragile	✓	✓	
South Cove Plaza east	2	Not fragile	✓	✓	
NEMC west building	1	Not fragile	✓		
Doubletree Hotel	2	Not fragile	✓	✓	
NEMC east building	1	Not fragile	✓		
NEMC south building	1	Not fragile	✓		
TOTAL IMPACTS			**19**	**16**	**4**

Table 6.9-13 – Summary of Predicted Construction Vibration Impacts: Charles Street Alignment

Site Name	FTA Receptor Category	Fragility	Vibration Impact	Ground-borne Noise Impact	Potential for Damage
Four Seasons Hotel	2	Not fragile		✓	
Radisson Hotel & Garage	2	Not fragile	✓	✓	
Residences (site 124)	2	Not fragile	✓	✓	
Apartments at Charles & Broadway	2	Not fragile	✓	✓	
Boston Chinese Church of Saving Grace	3	Not fragile	✓	✓	
Milner Hotel	2	Not fragile	✓	✓	
Offices/residential (site 131)	2	Not fragile	✓	✓	
Retail/residential (site 133)	2	Not fragile	✓	✓	
Lyndeboro Place Townhouses	2	Fragile	✓	✓	✓
Church of All Nations	3	Not fragile	✓	✓	
South Cove Plaza east	2	Not fragile	✓	✓	
NEMC west building	1	Not fragile	✓		
Doubletree Hotel	2	Not fragile	✓	✓	
NEMC east building	1	Not fragile	✓		
NEMC south building	1	Not fragile	✓		
TOTAL IMPACTS			**14**	**12**	**1**

Table 6.9-14 – Summary of Predicted Construction Vibration Impacts: Stuart Street Alignment

Site Name	FTA Receptor Category	Fragility	Vibration Impact	Ground-borne Noise Impact	Potential for Damage
Four Seasons Hotel	2	Not fragile	✓	✓	
Emerson College – Cutler Majestic Theater	6	Fragile	✓	✓	
Emerson College – Tufte Performance & Production Center	4	Not fragile		✓	
230 Tremont Street	2	Not fragile	✓	✓	
Future Loew's Boston Hotel	2	Not fragile	✓	✓	
Wilbur Theater	6	Fragile	✓	✓	✓
Wang Theater	6	Fragile	✓	✓	
Shubert Theater	6	Fragile	✓	✓	✓
Tremont Boston Courtyard by Marriott	2	Not fragile	✓	✓	
One Charles Street Condos	2	Not fragile	✓	✓	
New England School of Law	3	Not fragile	✓	✓	
Radisson Hotel & Garage	2	Not fragile	✓	✓	
Lyndeboro Place Townhouses	2	Fragile	✓	✓	
South Cove Plaza east	2	Not fragile	✓	✓	
NEMC west building	1	Not fragile	✓		
Doubletree Hotel	2	Not fragile	✓	✓	
NEMC east building	1	Not fragile	✓		
NEMC south building	1	Not fragile	✓		
TOTAL IMPACTS			**17**	**15**	**2**

Table 6.9-15 – Summary of Predicted Construction Vibration Impacts: Columbus Avenue Alignment

Site Name	FTA Receptor Category	Fragility	Vibration Impact	Ground-borne Noise Impact	Potential for Damage
Four Seasons Hotel	2	Not fragile		✓	
Boston Park Plaza Hotel	2	Fragile	✓	✓	✓
Baptiste Power Yoga	3	Not fragile	✓	✓	
Benjamin Franklin Smith Printers	1	Not fragile	✓		
Salvation Army Headquarters & Grill 23 Restaurant	3	Not fragile	✓	✓	
40 Isabella Street Condos	2	Fragile			✓
Isabella & Cortes Street Condos	2	Fragile			✓
TOTAL IMPACTS			**4**	**4**	**3**

Construction Staging Areas

Potential vibration effects from activities at construction staging areas were analyzed by alignment; the results are summarized in Table 6.9-16 below. Note however, that the final selection of the potential staging areas has not yet been made. Not all of the staging areas listed below would actually be used; rather, these are the sites being considered for use as staging areas. Thus, the "Total" tabulation of predicted adjacent land use impacts for each alternative (particularly for the Core Tunnel Segment) should be considered a conservative, worst-case estimate of potential impacts.

Table 6.9-16 indicates that with the Core Tunnel Segment, a maximum of 21 adjacent land uses (1 category 1, 15 category 2, and 5 category 3 uses) would experience vibration levels corresponding to "annoyance" compared to the FTA vibration impact criteria. Additionally, a maximum of 22 land uses would exceed FTA standards for ground-borne noise levels from construction vibration. The Core Tunnel Segment staging areas are not predicted to cause any vibration at adjacent land uses of a potentially damaging level, per FTA criteria.

The Tremont Street Alignment would result in a maximum of 20 adjacent land use impacts under the FTA vibration criteria for annoyance, and 18 ground-borne noise impacts. The Tremont Street Extension staging areas are not predicted to cause any vibration at adjacent land uses of a potentially damaging level, per FTA criteria.

The Stuart Street Alignment would result in a maximum of 20 adjacent land use impacts under the FTA vibration criteria for annoyance, and 18 ground-borne noise impacts. The Stuart Street Extension staging areas are not predicted to cause any vibration at adjacent land uses of a potentially damaging level, per FTA criteria.

The Charles Street Alignment would result in a maximum of 28 adjacent land use impacts under the FTA vibration criteria for annoyance, and 26 ground-borne noise impacts. The Charles Street Extension staging areas are not predicted to cause any vibration at adjacent land uses of a potentially damaging level, per FTA criteria.

The Columbus Avenue Alignment would result in a maximum of 15 adjacent land use impacts under the FTA vibration criteria for annoyance, and 18 ground-borne noise impacts. The Columbus Avenue Extension staging areas are not predicted to cause any vibration at adjacent land uses of a potentially damaging level, per FTA criteria daytime noise standard.

6.9.5.1 New England Medical Center Vibration Analysis

A detailed vibration assessment was conducted in the vicinity of the NEMC portal to identify construction period impacts to vibration-sensitive equipment at the NEMC and the MRI Unit on Washington Street. For this analysis, construction activities include hydromilling for the construction of the boat section at NEMC portal just south of the NEMC Floating Hospital and along Tremont Street for the cut-and-cover construction of a tunnel. Loaded trucks traveling along the boat section ramp, on Tremont Street, and along Washington Street in front of the MRI Unit were also assumed. The results of the analysis at NEMC are compared to International Standards Organization (ISO) vibration criterion for an operating theatre[9]. The results of the analysis at the MRI Unit are compared to the manufacturer's specifications for allowable vibration impacts for each individual piece of equipment[10]. A detailed discussion on the vibration analysis is included in Technical Appendix C.

[9] ISO vibration criterion for operating theatres is the most applicable measure to determine impacts to the use of microscopes (such as those in the NEMC 5th floor operating room) and typical clinical lab equipment (such as those in the NEMC 3rd floor clinical labs.

[10] See Table 2 in Harris Miller Miller & Hanson, Inc. *Silver Line Phase III Vibration Assessment: New England Medical Center* report included in Technical Appendix C.

Table 6.9-16 – Summary of Predicted Construction Vibration Impacts for Staging Areas

		Vibration Impact by FTA Receptor Type*						Ground-borne Noise by FTA Receptor Type *						Damage Potential by FTA Receptor Type *					
Alignment	**Staging Site**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Core Tunnel Segment	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	3	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	4	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	9	1	6	1	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	19	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Total	**1**	**15**	**5**	**0**	**0**	**0**	**0**	**16**	**5**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Tremont Street Alignment	8	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	9	1	6	1	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	1	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0
	13	3	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Total	**5**	**11**	**1**	**0**	**0**	**3**	**0**	**13**	**1**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
Charles Street Alignment	8	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	9	1	6	1	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	1	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0
	13	3	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	14	0	7	1	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0
	Total	**5**	**18**	**2**	**0**	**0**	**3**	**0**	**20**	**2**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
Stuart Street Alignment	8	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	9	1	6	1	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	1	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0

		Vibration Impact by FTA Receptor Type*						Ground-borne Noise by FTA Receptor Type *						Damage Potential by FTA Receptor Type *					
Alignment	**Staging Site**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
	13	3	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Total	**5**	**11**	**1**	**0**	**0**	**3**	**0**	**13**	**1**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**
Columbus Avenue Alignment	8	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	9	1	6	1	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	18	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
	Total	**1**	**12**	**2**	**0**	**0**	**0**	**0**	**13**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

* - FTA Vibration Land Use Category Description: (see Section 6.9.1)
1 Low interior ambient is essential
2 Residential & sleep
3 Institutional & daytime
4 Concert hall, TV/Recording studio
5 Auditorium
6 Theater

Vibration levels at the NEMC 3rd-floor clinical lab and the 5th-floor operating rooms from loaded trucks traveling on the boat section ramp are projected to be four to five decibels below the ISO vibration criterion for an operating theatre. Vibration levels at the 3rd-floor clinical lab and the 5th-floor operating rooms from hydromilling operations are projected to be 25 decibels or more below the criterion for an operating theatre.

Vibration levels at the MRI Unit from loaded trucks traveling along Washington Street (passing the MRI Unit northbound or southbound) are projected to be 10 decibels above the manufacturer's specification for "transient"[11] vibration in the 16-Hertz 1/3-octave band. Vibration levels from loaded trucks traveling on the boat section ramp at the NECM portal or along Tremont Street are expected to be 10 decibels or more below the "transient" vibration specification. Vibration levels from hydromilling at the Staging Site 13 (BRA Parcel) are projected to be 10 decibels or more below the manufacturer's specification.

6.9.6 Construction Period Vibration Mitigation

As previously discussed in Section 6.2.3, the following mitigation measures (see Table 6.19-17) will be employed by the MBTA to mitigate the vibration impacts from construction activities. The Noise and Vibration Technical Report (included as Technical Appendix C) lists the specific combination of mitigation measures proposed for each impacted receptor. It is believed that application of these measures will mitigate the construction vibration impacts below the FTA criteria and will result in minimizing the probability for damage to fragile buildings. A recommendation for mitigating potential vibration impact at the MRI units from loaded trucks traveling on Washington Street is to reroute the trucks to avoid the MRI Unit on Washington Street.

Table 6.9-17 – Construction Vibration Mitigation Measures

Type	Description
Monitoring and Instrumentation	The installation of instruments throughout the building to be used in monitoring and recording building behavior (movements, vibrations) due to adjacent tunneling activities.
Soil stabilization under foundation	Any physical, chemical or biological method, or any combination of such methods, used to increase the bearing capacity or decrease the permeability of soils under the foundation of existing buildings.
Compensation grouting	A specialized form of grouting used to compensate for movements and settlements caused by tunneling adjacent to or beneath existing buildings.
Foundation underpinning	The introduction of additional support or enlarging of the foundation elements of a building to accommodate deeper, new construction adjacent to the building.

Source: DMJM Harris/URS Joint Venture, 2005

[11] "Transient" vibration specification is applicable to vibrations produced from sources such as vehicular traffic, pedestrian motion or doors closing.

Vibration levels on Tremont Street would be monitored continuously during demolition activities of the abandoned Green Line tunnel and the existing Silver Line Phase II tunnel using an automated vibration measurement/monitoring system. The monitor would instantaneously alert construction personnel if vibration exceeds a level of 0.20 in/sec. If this threshold is exceeded, demolition work would cease and alternative demolition methods shall be used.

6.10 Maintenance of Traffic

This section describes the construction period impacts on traffic operations during construction of the Core Tunnel Segment and each of the alignment alternatives for Silver Line Phase III. Information regarding the traffic analysis and overview of the proposed measures to mitigate and manage the impacts is also presented. Mitigation of construction impacts on pedestrians, parking and bicycles is also discussed in this section.

The objective during the construction phase is to maintain adequate vehicular and pedestrian traffic circulation around and through the work areas. Traffic will be mostly affected (i.e. loss of traffic lanes and crosswalks) during the early phases of the project when and where cut-and-cover operations are required. All streets, including Essex Street and Boylston Street will continue to be used throughout the construction period. However, detours are proposed for a portion of Essex Street and Boylston Street that will be temporarily closed to support construction of Silver Line Phase III stations. During construction, access for all vehicles and pedestrians will be maintained, especially for emergency vehicles near the New England Medical Center.

During cut-and-cover operations, one half of the street will typically be occupied at any one time, with traffic flow reduced to one travel lane. Soil stabilization activities could also be performed from the surface, which, for a short duration would occupy half of the street at any one time. These activities may occur separately or concurrently, depending on the project staging and tunneling schedule that is established. There may also be periodic traffic detours when certain sections of roadway need to be occupied. Cut-and-cover activity is anticipated along Essex Street/Boylston Street for the required interface with the Phase II tunnel at South Station; construction of the Chinatown and Boylston Silver Line Stations; and along Tremont Street from Boylston Street to the NEMC portal. At the NEMC portal area, cut-and-cover operations will extend across Tremont Street through Elliot Norton Park for the Charles Street Alternative. The Tremont Street and Stuart Street Alternatives would require more cut-and-cover construction as defined in Section 6.2. At the Columbus Avenue portal area, cut-and-cover operations will occupy the westbound half of Columbus Avenue, allowing cars on the other half. In most locations, slurry walls will be installed to support the tunneling works. Once the slurry walls are installed, the excavated area will be decked-over and normal traffic circulation can resume at street level.

A comprehensive Traffic Maintenance Plan will be developed for the entire project for the preferred alternative after consultation with Boston Transportation Department, New England Medical Center, Boston Police Department, and other city and state agencies. This plan will be part of the design package for implementation by the contractor. It is likely that the Traffic Management Plan will be reviewed and modified as construction progresses to accommodate the changing environment and stakeholders' concerns.

As part of the Construction Management Plan and Traffic Management Plan, the MBTA will establish truck routes for material and equipment deliveries and excavate and material removal. The allowable truck routes will also take into account the work hour restrictions established in the Construction Management Plan. The number of daily truck trips is dependent on construction phasing, progress of work, truck routing, and size of trucks to be used.

A comprehensive plan for maintenance of pedestrian access will also be developed for the entire project after consultation with city and state agencies and authorities. Unrestricted pedestrian access that meets current accessibility requirements is required for all properties and businesses abutting the project. A plan will be developed in sufficient detail, for implementation by the contractor, such that it recognizes phases of construction and provides a uniform and recognizable "kit of parts" for barriers and signs associated with pedestrian walkways and access. Outreach to local businesses will be conducted to develop a sign plan for use on pedestrian barriers. The contractor will be required to maintain pedestrian access in the work zone, remove snow and ice, and repair and repaint barriers when necessary.

6.10.1 Core Tunnel Segment

The Core Tunnel Segment is common to all Silver Line Phase III Build Alternatives, regardless of where the portal location is. This segment consists of approximately 3,000 feet of tunnel within the Essex Street and Boylston Street right-of-way extending between the existing Silver Line Phase II tunnel at South Station and Charles Street. The new Chinatown Silver Line Station will be located along the Essex Street right-of way below the existing Chinatown Station. The new Boylston Silver Line Station will be located directly below and aligned with Boylston Street, adjacent to the existing Green Line tunnel between Tremont Street and 134 Boylston Street. Due to right-of-way restrictions, the Silver Line tunnel alignment is stacked at both station locations. The Core Tunnel Segment construction includes both mined and cut-and-cover excavation

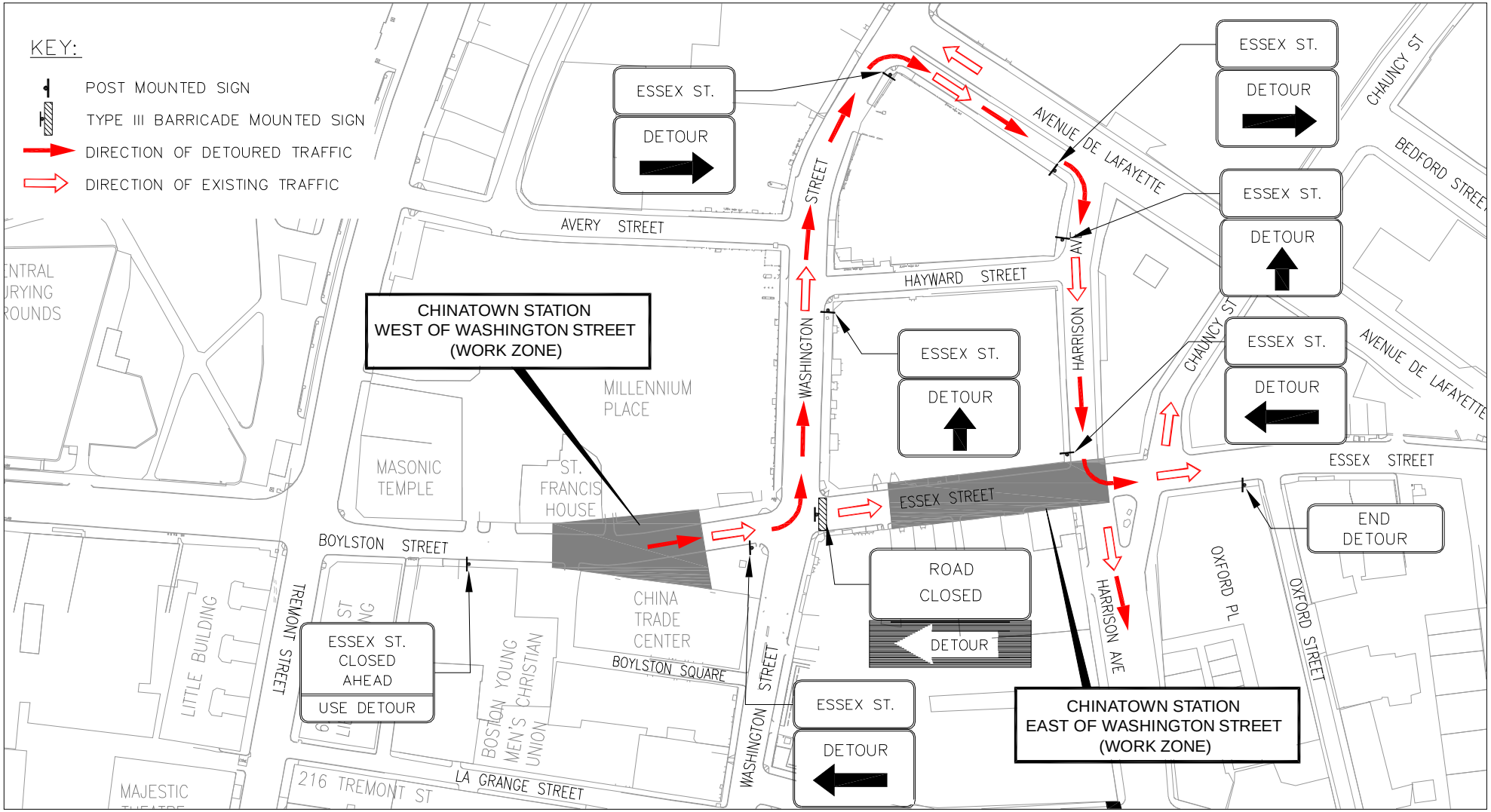
When cut-and-cover construction takes place along the street, partial or complete roadway closures would be required. These closures, although temporary in nature (until temporary decking can be placed over the excavated area) would impact the traffic operations in an adverse manner and require mitigation strategies to provide for safe operations and to manage and minimize the impacts.

Construction of the Core Tunnel Segment would require complete closure of one block of Essex Street between Washington Street and Harrison Avenue during certain construction periods to facilitate and expedite construction. This roadway closure would occur during off peak hours only, since this segment of Essex Street is heavily traveled during peak hours. Essex Street, between Washington Street and Harrison Avenue is a one-way roadway eastbound and includes two travel lanes, with parking allowed at both sides of the street. The detoured traffic would turn left onto Washington Street at the intersection with Essex Street, turn right onto Avenue De Lafayette, and turn right onto Harrison Avenue Extension and travel south to reach Essex Street at the intersection with Harrison Avenue. There will be no need to change the direction of any of the streets, since they are all one-way streets along the direction of the detoured traffic. The detour plan for Essex Street closure between Washington Street and Harrison Avenue is shown in Figure 6.10-1.

The cut-and-cover construction associated with the Core Tunnel Segment would require partial roadway closures along Atlantic Avenue, Essex Street, Boylston Street, and Charles Street South. These partial closures generally require the temporary loss of either a travel lane or a parking lane, or both. These partial roadway closures will occur at the following locations:

Intersection of Atlantic Avenue and Essex Street

- Essex Street reduced to one lane of traffic
- Atlantic Avenue most westerly lane closed to traffic
- Sidewalks on both sides of Essex Street to remain open unless in direct conflict to slurry wall layout
- One Financial Center underground parking on Essex Street to remain open
- Access to all store fronts along Atlantic Avenue to remain open


KEY:
POST MOUNTED SIGN
TYPE III BARRICADE MOUNTED SIGN
DIRECTION OF DETOURED TRAFFIC
DIRECTION OF EXISTING TRAFFIC
ESSEX ST.
DETOUR
AVERY STREET
WASHINGTON STREET
AVENUE DE LAFAYETTE
CHAUNCY ST
BEDFORD STREET
HAYWARD STREET
HARRISON AVE
ESSEX STREET
CHINATOWN STATION
WEST OF WASHINGTON STREET
(WORK ZONE)
MILLENNIUM
PLACE
MASONIC
TEMPLE
ST.
FRANCIS
HOUSE
BOYLSTON STREET
TREMONT STREET
LITTLE BUILDING
CHINA
TRADE
CENTER
BOYLSTON SQUARE
ESSEX ST.
CLOSED
AHEAD
USE DETOUR
BOSTON YOUNG
MEN'S CHRISTIAN
UNION
LA GRANGE STREET
216 TREMONT ST
MAJESTIC
ROAD
CLOSED
DETOUR
OXFORD PL
OXFORD STREET
END
DETOUR
CHINATOWN STATION
EAST OF WASHINGTON STREET
(WORK ZONE)
N
0 50 100 150 200
FEET

Intersection of South Street and Essex Street
- Essex Street reduced to one lane of traffic
- Sidewalks on both sides of Essex Street to remain open unless in direct conflict to slurry wall layout
- Access to all store fronts along Essex Street to remain open

Intersection of Lincoln Street and Essex Street
- Essex Street reduced to one lane of traffic
- Sidewalks on both sides of Essex Street to remain open unless in direct conflict to slurry wall layout
- Access to all store fronts along Essex Street to remain open

Intersection of Harrison Avenue and Essex Street
- Essex Street reduced to one lane of traffic
- Sidewalks on both sides of Essex Street to remain open unless in direct conflict to slurry wall layout
- Access to all store fronts along Essex Street to remain open

Chinatown Station; west of Washington Street
- Essex Street reduced to one lane of traffic
- Sidewalks on both sides of Essex Street to remain open unless in direct conflict to slurry wall layout
- Access to all store fronts along Essex Street and Washington Street to remain open

Intersection of Boylston Street and Charles Street
- Charles Street South most easterly lane closed to traffic
- Sidewalks on both sides of Charles Street South to remain open unless in direct conflict with slurry wall layout
- Access to all store fronts along Charles Street South to remain open

6.10.2 Proposed Boylston Street Roadway Changes

The project proposes to make Boylston Street a one-way eastbound roadway between Tremont Street and Charles Street during construction of the proposed Boylston Station as part of the Core Tunnel Segment. The conversion of Boylston Street from two-way to a one-way, eastbound roadway would facilitate and expedite construction by providing additional work area. Any changes to conditions on Boylston Street would be undertaken with the approval of the Boston Transportation Department.

Currently, Boylston Street is a two-way roadway between Tremont Street and Charles Street, with one westbound and two eastbound lanes. This is the only block of Boylston Street which has a westbound lane; all other sections of Boylston Street within downtown Boston are one-way eastbound. All westbound traffic in this segment of Boylston Street along Boston Common comes from southbound vehicles on Tremont Street turning right at the intersection of Boylston Street and Tremont Street. Upon reaching the intersection with Charles Street, this traffic turns right onto Charles Street northbound. The temporary closure of the Boylston Street westbound lane would require this traffic to be detoured by traveling southbound on Tremont Street to the intersection with Stuart Street, turning right onto Stuart Street to the intersection with Charles Street South, and turning right onto Charles Street South to the intersection with Boylston Street. This detour is shown in Figure 6.10-2.

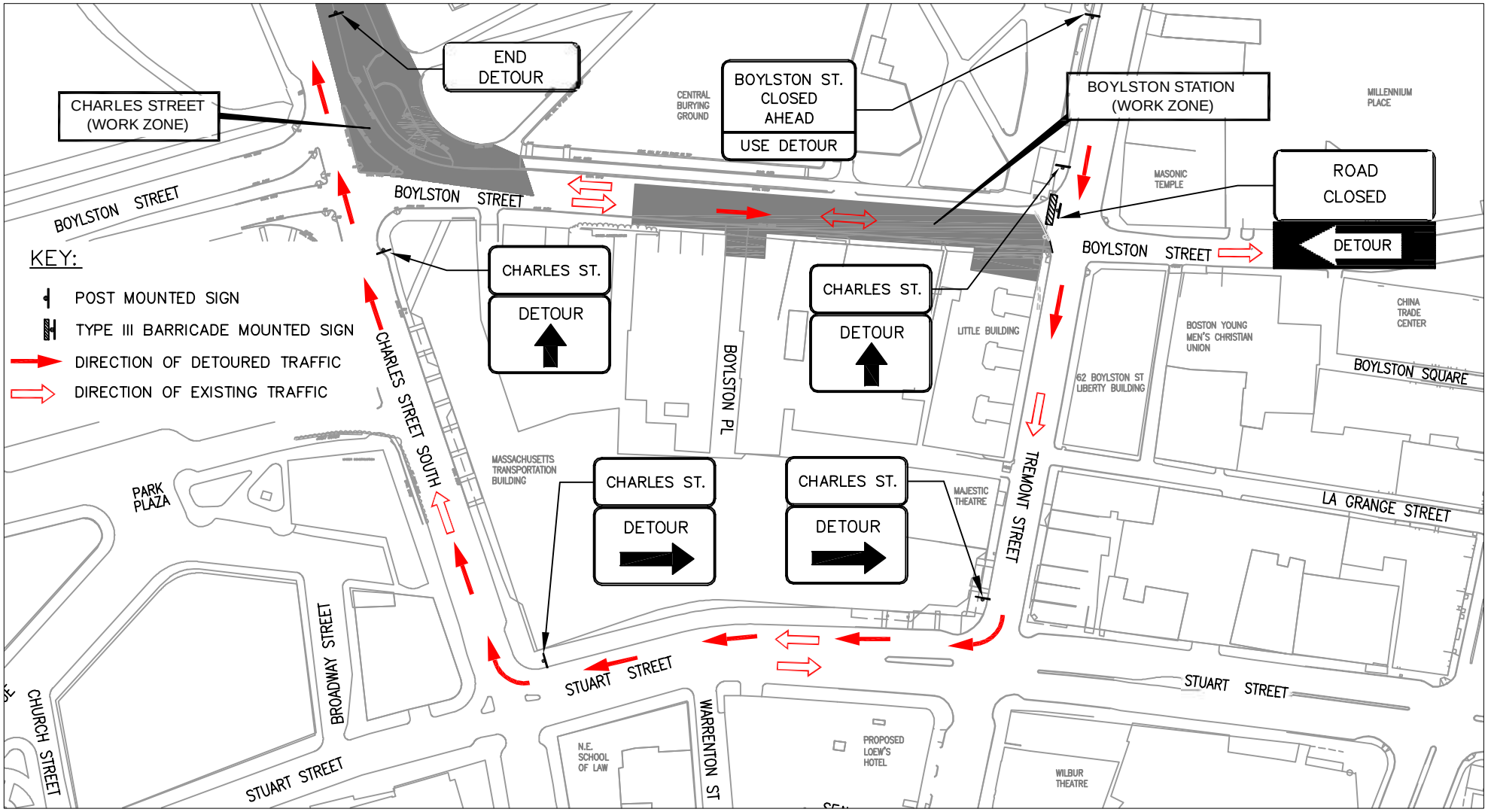


Figure 6.10-2
Boylston Street Westbound Traffic Detour Plan

The detoured traffic would affect Boylston Street, Tremont Street, Stuart Street, and Charles Street along with the following four intersections:

- Boylston Street/Tremont Street
- Tremont Street/Stuart Street
- Stuart Street/Charles Street South
- Charles Street/Boylston Street

Level of Service (LOS) analyses have been performed at the above locations in order to determine the traffic impacts associated with conversion of Boylston Street to a one-way roadway, between Tremont and Charles Streets. Analyses have been performed for 2004 Existing Conditions, 2013 No-Build (without the one-way conversion) Conditions and 2013 Build (with the one-way conversion) Conditions. This traffic counts and analytical results are presented in Technical Appendix D.

The Boylston Street one-way conversion and consequent detour would cause LOS deterioration at two locations, compared to the 2013 No-Build conditions. However, it should be noted that all four intersections would operate at acceptable conditions (LOS D or better) during both the morning and evening peak hours with the proposed Boylston Street westbound lane closure. The LOS at the Stuart Street/Charles Street South intersection would deteriorate from C to D during the evening peak hour. The LOS at the Charles Street/Boylston Street intersection would deteriorate from B to C during the morning peak hour. Among all four locations, the intersection of Stuart Street/Charles Street South would be the most adversely impacted, with the average stopped delays per vehicle increasing 13.9 seconds (from 29.4 to 43.3) during the evening peak hour, compared to the 2013 No-Build Conditions.

6.10.3 Tremont Street Alignment

The Tremont Street Alignment connects to the Core Tunnel Segment at the intersection of Boylston and Tremont Streets. It extends south within the Tremont Street ROW to a portal on Washington Street between the NEMC garage and the Doubletree Hotel. Because the presence of the existing Tremont Street Subway Tunnel precludes the use of mining as a viable construction method, this alternative alignment would need to be constructed by a cut-and-cover method along its entirety, causing increased disruption to traffic and abutters during the construction phase. While no complete roadway closures are anticipated for this alignment, partial roadway closures would occur.

Partial roadway closures along Tremont Street, from the intersection with Boylston Street to a point just south of the NEMC garage, would occur to support slurry wall construction. The construction would take place in two stages. During each stage the parking lane on each side of the roadway and the adjacent travel lane will be lost and connected to construction zone, maintaining two travel lanes for traffic at all times. Tremont Street sidewalks and access to all businesses will remain open during normal business hours.

6.10.4 Charles Street Alignment

The Charles Street alignment consists of a tunnel that extends south from the Core Tunnel Segment along Charles Street South, to a portal located between the NEMC parking garage and the Doubletree Hotel. The tunnel alignment would be located within the Charles Street ROW in a stacked arrangement, transitioning to a side-by-side arrangement before crossing under Elliot Norton Park. The tunnel then crosses under Tremont Street ascending to a portal and ramp to grade at Washington Street. The tunnel segment within Charles Street ROW would be mined, thereby reducing the potential for impacts to traffic and abutters at the surface. The tunnel segment through Elliot Norton Park is shallower as it approaches the portal, requiring construction by a cut-and-cover method, all the way to the portal, at Washington Street. The

combination of mining and cut-and-cover excavation would not require any complete roadway closures. However, partial roadway closures would occur to support construction.

Although the tunnel segment within the Charles Street right-of-way would be mined, the construction would require lane closures along Charles Street South, from the intersection with Tremont Street to Elliot Norton Park. The work zones along Charles Street South would require one lane closure (travel or parking) and would be 100 to 150 feet in length.

Charles Street South sidewalks and access to all businesses will remain open during normal business hours.

6.10.5 Stuart Street Alignment

The Stuart Street alignment extends from the Core Tunnel Segment at the Boylston Street and Charles Street intersection south along the Charles Street ROW. The tunnel alignment then turns easterly under Stuart Street staying within the ROW in a stacked arrangement. The alignment then follows the Tremont Street alignment in a parallel tunnel arrangement, turning east near the NEMC parking garage to a tunnel portal located east of the Tremont Street easterly ROW line. The alignment continues to the east in an open boat section, ending at Washington Street at a point north of the Doubletree Hotel and south of the NEMC garage.

The Stuart Street alignment tunnel would be mined along Charles Street and Stuart Street, and constructed by a cut-and-cover method along Tremont Street. This alternative reduces the quantity of cut-and-cover construction associated with the Tremont Street alignment, thereby reducing roadway closures. The combination of mining and cut-and-cover excavation would not require any complete roadway closures. However, partial roadway closures would occur to support construction.

Although the tunnel segment within Stuart Street ROW would be mined, the construction would require lane closures from the intersection with Charles Street South to the intersection with Tremont Street. The work zones along Stuart Street would require one lane closure (travel or parking) and would be 100 to 150 feet in length. Charles Street South sidewalks and access to all businesses will remain open during normal hours.

6.10.6 Columbus Avenue Alignment

The Columbus Avenue alignment extends from the Core Tunnel Segment at the Boylston Street and Charles Street South intersection southwest within the Columbus Avenue ROW to the Arlington Street intersection. Continuing westerly, the tunnels extend to a portal west of Arlington Street and then rises to the surface east of the Berkeley Street intersection.

The Columbus Avenue Portal would eliminate the two westbound travel lanes of Columbus Avenue between Arlington and Berkeley Streets. Permanent traffic impacts associated with this alternative are discussed in Chapter 5.

This alternative would be constructed by a cut-and-cover method from the portal to a point approximately 100 feet east of the Arlington Street/Columbus Avenue intersection. From that point to the Core Tunnel Segment, the Columbus Avenue tunnel would be mined, thereby reducing the potential for impacts to traffic and abutters at the surface during construction. The combination of mining and cut-and-cover excavation would not require any complete roadway closures. However, partial roadway closures would occur to support construction.

The mined segment of the tunnel within Columbus Avenue ROW, from the Core Tunnel Segment to a point east of the intersection with Arlington Street, would require work zones that occupy one travel or parking lane. These movable work zones would be 100 to 150 in length. The slurry wall

construction (cut-and-cover method) along Columbus Avenue will take place in two stages. During each stage the parking lane on each side of the roadway and the adjacent travel lane will be lost to construction zone.

6.11 Air Quality Impacts during Construction

Any air quality impacts during construction will be localized and temporary. Impacts generally will be associated with the operation of construction vehicles and machinery, and from dust raised by construction activities such as excavation. Traffic delays or diversions associated with construction activity may also result in temporarily degraded local air quality.

Air quality degradation due to vehicle emissions (both construction-related vehicles and other vehicles affected by construction activities) will be minimized by the implementation of a traffic maintenance plan, as described in Section 6.10. This will facilitate the flow of traffic in and around the work areas. Additionally, as part of DEP's Clean Construction Initiative and as required by the Transit Commitments Administrative Consent Order between DEP and the Executive Office of Transportation (EOT), all diesel construction equipment used in the Silver Line Phase III construction contracts will have emission control devices installed, such as oxidation catalyst or particulate filters on the exhaust system side of the diesel combustion engine equipment. The contractor will be required, at the time of contract bidding, to certify that all equipment will have such emission control devices. Unnecessary idling of vehicles, machinery, and motorized equipment will be avoided. Dust control measures also will be implemented, including frequent watering of construction and staging sites, washing of tires before vehicles leave a site, and securing and covering excavate before it is hauled off-site.

Mitigation measures will be coordinated with the BTD and other city and state agencies having jurisdiction, such as the Boston Environment Department, as well as with abutting property owners and businesses.

6.12 Rodent Control

MBTA Standard Construction Specifications include provisions for controlling rodents prior to and during excavation and site preparation activities. The specification sets forth requirements for certified exterminators holding a current license with the Massachusetts Pesticide Board to prepare and execute a rodent control plan. This specification will be included for the Silver Line Phase III project.

6.13 Construction Phase Mitigation Summary

Construction of the Silver Line Phase III will result in temporary impacts to support construction activities. The tunnel design for the Core Tunnel Segment and each of the four alignment alternatives has been developed to minimize impacts during construction to the greatest extent feasible. The tunnels are within roadway rights-of-way below ground, and in some cases are stacked to avoid adjacent structures and buildings. There are several mitigation measures that can be utilized to minimize surface impacts during construction, as discussed in prior sections.

In general, a Construction Management Plan will be developed to address all aspects of construction including potential impacts and mitigation strategies. Construction mitigation measures include:

- A Utilities Support, Protection and Relocation plan will be prepared to address subsurface utilities;
- A Traffic Management Plan will be prepared in collaboration with the Boston Transportation Department to identify detours and lane closings;
- A Soils Management Plan will be developed to establish procedures for characterizing, reusing, and disposing soils;
- Construction noise and vibration will be minimized to the extent possible;
- Impacted parklands will be restored, at a minimum, to their present day condition;
- Impacts to historic and archaeological resources will be minimized and monitored throughout construction;
- A program will be established to monitor movements in adjacent structures and provide corrective action;
- A Project Conservator will monitor criteria and mitigation measures for protecting historic and archaeological resources during construction, in accordance with the MHC Programmatic Agreement;
- Construction vehicles will have emission reducing control devices in accordance with DEP's Clean Construction Initiative; and
- A rodent control plan will be developed.

In addition, construction of the Silver Line Phase III will be controlled by the MBTA contract specifications and will comply with all local, state and federal standards. These specifications will include provisions to protect abutters and adjacent communities from impacts anticipated during construction.

Through the Silver Line Communications and Community Development Office (SLCO), a Community Liaison will inform nearby residents and businesses on construction progress and activities as well as to advise the MBTA on community concerns throughout the construction period. More specifically, the SLCO and Community Liaison would:

- Continue to coordinate the community participation process;
- Coordinate with residential communities on plans for Silver Line construction, including construction techniques, schedules, and anticipated impacts;
- Respond to community concerns both before and during construction activities; and
- Develop a mitigation package to minimize serious financial impacts and logistical disruptions impacting the operations of these businesses. Potential strategies under consideration include:
    - Meeting with businesses once construction staging areas are selected to determine their access needs and integrating these requirements into the construction plan;
    - Briefing area businesses on the construction management and traffic management plans developed to minimize street level impacts; and

- Providing an information package to each business owner with pertinent information, names and contact of construction representatives and utility companies to contact in case of an emergency.

A proactive strategy of building and maintaining ongoing dialogue between the Community Liaison and impacted residents will help ensure that construction related issues are efficiently addressed. The construction methods and mitigation plans presented in this section were selected to minimize disruptions to residents and business operations. A multi-tiered community involvement plan will be implemented to provide the best possible experience for each impacted residential community and business. This plan will include working with the City of Boston Transportation Department to prepare a comprehensive Construction Management Plan; coordination with the Boston Groundwater Trust; meeting with affected businesses in advance of construction to discuss the likely impacts and to obtain feedback and respond to questions and concerns generated by the impacted parties; and providing access to a community liaison to respond to questions and concerns.

CHAPTER 7.0 Evaluation of Alternatives

7.1 Introduction

This chapter provides a comparative evaluation of the potential benefits and impacts of the Silver Line Phase III Baseline Alternative and the four Build Alternative alignments – Tremont Street, Charles Street, Stuart Street and Columbus Avenue. The alternatives are evaluated according to the following criteria:

- The ability to satisfy the project Purpose and Need as stated in Chapter 1;
- The ability to meet Bus Rapid Transit (BRT) performance characteristics;
- Their potential environmental impacts, both long term and during the construction phase; and
- How they would rate against Federal Transit Administration (FTA) New Starts criteria.

These criteria are intended to assist in framing the public dialogue on the evaluation of alternatives.

Generally, a comparative evaluation shows that all four Build Alternatives meet the purpose and need far better than the No-Build or the Baseline Alternative, and all four would rate well against the New Starts criteria.

When comparing the four Build Alternatives in terms of their ability to meet BRT performance characteristics, it is clear that the Charles Street and Columbus Avenue alternatives better meet the performance characteristics of BRT. The Tremont Street alternative involves reliability problems because of an at-grade crossing of the high-frequency bus flows in the Core Tunnel Segment immediately to the east of Boylston Station. It also presents a serious passenger comfort problem in requiring the use of the tight radius and steep Charles Street/Boylston Street turnaround loop for revenue passenger service. The other three alternatives have no such crossing movements, and use the turnaround loop only for non-revenue movements. In addition, the Tremont Street alternative requires the use of two additional right-angle small radius curves in conjunction with steep grades. These issues make the Tremont Street alternative the least preferable of the four in terms of BRT performance criteria. Likewise, the Stuart Street alternative involves three right-angle, tight radius curves, two of them at steep grade; this makes the ride characteristics less consistent with BRT performance characteristics than either the Charles Street or Columbus Avenue alternatives, both of which provide better quality BRT characteristics.

In considering the environmental impacts of the four alternatives, again the Tremont Street and Stuart Street alternatives appear less preferable than the Charles Street and Columbus Avenue alternatives. The Tremont Street alternative involves the permanent destruction of most of the historic Tremont Street Subway Tunnel. This would require significant cut-and-cover construction in Tremont Street to demolish the old tunnel and build the new one at a lower elevation, causing serious traffic management challenges and greater noise and vibration impacts during construction. The Tremont Street alternative would require additional construction under Boylston Street to accommodate bypass lanes when compared to the other three alternatives causing greater disruption of Boylston Street during construction. Again, this results in Tremont being the least favorable of the four alternatives.

The Stuart Street alternative also requires destruction of part of the historic Tremont Street tunnel structure, with significant traffic disruption and noise and vibration impacts during construction. While it involves less severe impacts than the Tremont Street alternative, the Stuart Street alternative clearly has greater permanent and construction period impacts than Charles Street or Columbus Avenue, so the two alternatives that are superior from a service quality perspective

also have less environmental impact. However, the Charles Street alternative does entail the temporary use of Elliot Norton Park, which would require approval of the state legislature under Article 97 of the Constitution of the Commonwealth of Massachusetts, which protects public parks from being converted to other uses. In contrast, the Columbus Avenue alternative avoids parklands.

While efforts to develop mitigation strategies for all temporary and permanent impacts are ongoing, it is clear that Charles Street and Columbus Avenue are superior to the Stuart Street and Tremont Street alternatives, both in terms of providing high-quality service to riders and in terms of avoiding or minimizing temporary and permanent environmental impacts.

7.2 Ability to Satisfy the Project Purpose and Need

The goals reflected in the Purpose and Need address the potential transportation benefits of the Silver Line Phase III Alternatives:

- Provide a connection between Silver Line Phase I and Phase II services;
- Enhance connections to existing Massachusetts Bay Transportation Authority (MBTA) rapid transit services;
- Improve mobility and travel times for Boston's residential neighborhoods; and
- Reduce transportation congestion within Boston's Urban Core.

7.2.1 Provide a Connection between Silver Line Phase I and Phase II

The Baseline Alternative would not provide a direct connection between Silver Line Phase I and Phase II services. Passengers using Phase I or Phase II service would either need to transfer to the Red Line or walk to make the connection between the current termination points at Downtown Crossing (Phase I) and South Station (Phase II).

In contrast, all Build Alternatives would provide a direct connection between Silver Line Phases I and II. The Core Tunnel Segment, common to all Build Alternatives, would connect with Phase II, extending from South Station to the federal courthouse and World Trade Center, and Boston Convention and Exhibition Center (BCEC) on the South Boston Waterfront. The New England Medical Center (NEMC) Portal Alternatives (Charles, Tremont and Stuart) would connect directly at the portal with Phase I, in operation along Washington Street between Dudley Square and downtown. After exiting the portal on Columbus Avenue and traveling a short distance along surface routes, the Columbus Avenue Alternative would connect with Phase I service on Washington Street at Herald Street for outbound service. The inbound route would leave Washington Street at East Berkeley Street to access the portal. (See Figure 3.5-3.) Each alternative would satisfy the project objective for a passenger boarding in Dudley Square to be able to ride on one bus, without transfers, to reach a destination in downtown, the Waterfront or at Logan Airport.

7.2.2 Enhance Connections to Existing MBTA Rapid Transit Services

While the Baseline Alternative would increase the frequency of service on Silver Line Phase I and Phase II and provide a new surface bus route between Back Bay and Downtown Crossing, no new connections to other MBTA rapid transit services would be created. Connections from Phase I service would remain as they exist today. Passengers would need to transfer from service on a surface route in order to access underground stations at Boylston Street (for the Green Line) or at Chinatown (for the Orange Line) or Downtown Crossing (for the Orange and Red Line). Two transfers would be required to access Silver Line Phase II and the jobs and services of the growing South Boston Waterfront District and the airport.

In contrast, all of the Build Alternatives would provide a direct passenger connection between Silver Line Phase III and existing underground rapid transit services, at the Orange Line

Chinatown Station or at the Green Line Boylston Station. The Silver Line Chinatown Station would be located beneath the Orange Line Station, with a direct connection provided via stairways and escalator. The Silver Line Boylston Station would be connected to the Green Line station via a mezzanine level providing a convenient, direct connection between the two transit lines. (See Section 3.4.1 for additional discussion.)

7.2.3 Improve Mobility for Boston's Residential Neighborhoods

A major goal of the project is to expand the opportunities for Boston residents located within urban neighborhoods, including Roxbury, Chinatown, Midtown, the Back Bay, the South End, and South Boston to access downtown Boston, the Waterfront area, and the Logan Airport. The success of the Phase III alternatives in meeting that goal is measured by the ability of each alternative to attract transit riders through improved service, reduced travel times, and fewer transfers.

Another measure of mobility is quantified in terms of user benefits. User benefits are measured in hours of travel time savings per year for the entire MBTA system; these benefits are calculated by SUMMIT, software created by the Federal Transit Administration (FTA) and applied to all New Starts projects nationwide to ensure consistency and comparability of results. In accordance with FTA requirements, user benefits for New Starts projects such as the Silver Line are calculated in comparison to a Baseline Alternative.

As discussed in more detail in Chapter 3, the Baseline Alternative does not measurably increase Silver Line ridership in comparison to the No-Build Alternative. In contrast, all four Phase III Build Alternatives improve mobility for Boston residents through the achievement of substantial ridership benefits. The NEMC portal alternatives (Tremont, Charles, and Stuart Street) are projected to increase Silver Line ridership to 160,228 daily boardings, while the Columbus Avenue alternative attracts 153,940 daily boardings to the Silver Line. This represents, respectively, a 176 percent and 165 percent increase over the No-Build; the No-Build assumes no Phase III tunnel connection between existing Phases I and II.

Related to the significant increase in Silver Line ridership, the Phase III tunnel connection will also reduce the travel time to and from key markets in the Boston area. This is a result of the direct tunnel connection provided between Phases I and II and the associated reduction in transfers between transit services. For example, for trips originating at Dudley Square, riders will enjoy travel time savings of up to nine minutes to the Financial District, and up to 10 minutes for the Waterfront area. Similar savings accrue for trips originating in the Back Bay, with up to eight minutes of savings for trips destined to the Financial District and up to 10 minutes for trips destined to the Waterfront.

These and other travel time savings presented in Chapter 3 are the result of the direct connection between Phases I and II, as well as new direct connections between the Silver Line and the Green and Orange Lines. Those direct connections will greatly reduce the time it takes for transit riders to reach key destinations throughout the region. In total, the NEMC portal alternatives are projected to result in daily travel time savings of nearly 18,475 minutes while the Columbus Avenue portal results in 18,600 minutes of savings each day.

The differences between ridership and travel time savings results for the three NEMC portal alternatives and the Columbus Avenue alternative are negligible: less than a four percent difference in ridership and less than one percent in travel time savings. For this reason, all Build Alternatives achieve roughly the same level of mobility improvements for Boston's residential neighborhoods.

7.2.4 Reduce Congestion

All of the Build Alternatives are more effective in diverting regional trips from auto to transit compared to the No-Build and Baseline Alternatives. The reduction in vehicle miles traveled (VMT) and vehicle hours traveled (VHT) would be similar for all Build Alternatives (see Table 7.2-1).

Because of the reduction in VMT, there would be substantial reduction in daily regional vehicle miles of travel, thereby producing region-wide air quality benefits as a result of reduced emissions of nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOCs), compared to the No Build and Baseline Alternatives.

Table 7.2-1 – Changes in Daily Regional Vehicle Travel and Air Quality from Phase III Operations compared to the No-Build Alternative

2025 Alternative	VMT	VHT	CO (lbs)	NOx (lbs)	VOC (lbs)
No-Build	106,131,900	3,366,200	1,962,909	48,325	47,752
Baseline	-14,400	-600	-220	-0	-0
Tremont, Charles, and Stuart Street Alternatives	-43,400	-2,400	-794	-22	-22
Columbus Ave Alternative	-46,300	-2,900	-860	-22	-22

Source: CTPS, 2/23/05
Note: kg=kilograms

As discussed in more detail in Chapter 5, at the local level the NEMC portal Build Alternatives (Tremont, Charles and Stuart Street) result in similar levels of service at intersections along the Washington Street corridor as there are under the No-Build Alternative. The Columbus Avenue Alternative results in an improvement in level of service (LOS) at the Arlington/Stuart/Columbus intersection, since it removes the west-bound traffic move on Columbus, thereby simplifying intersection operations.

7.2.5 Conclusion

All of the Silver Line Phase III Build Alternatives fully satisfy the evaluation criterion of meeting the project purpose and need.

7.3 Bus Rapid Transit Performance Characteristics

7.3.1 Introduction

As discussed above, the Phase III component of the Silver Line serves to not only link the earlier Phases I and II physically, but it also will leverage those investments to create a fifth transit line that traverses the existing transit grid in Boston's Central Business District (CBD). This line provides key system interconnections and reconnection of neighborhoods in order to improve mobility and meet travel demand effectively and efficiently.

BRT is the cornerstone of the Silver Line. It is defined as: "A flexible, high performance rapid transit mode that combines a variety of physical, operating and system elements into a permanently integrated system with a quality image and unique identity:"[1]

Bus Rapid Transit as implemented in Boston under Phase I and Phase II of the Silver Line meets this definition through a well conceived and carefully executed approach to planning and design of the fixed facility, vehicle selection, and operational/service planning decisions. For these phases, as well as for Phase III, strategically located portals support multiple surface routes, offering the flexibility for service planners to respond to changing travel demand and patterns. The tunnel segments and stations provide the exclusive right-of-way (ROW) for the vehicles and direct transfers for passengers in this highly traveled urban core, to attain the required high performance from the system.

Silver Line Phase I vehicles operate within dedicated lanes in the Washington Street corridor. Phase II, which is located in an environment slated for a significant increase in high density development, operates in dedicated travelways in tunnels. These decisions were appropriate given the conditions, service demand and need and desire to run a 'flexible and high performance system'. Phase III will also operate in tunnels in its route through the densely developed urban core of the City, which is characterized by narrow streets, tight intersections, and peak hour traffic congestion.

Additional time and effort has been expended in refining the Phase III alignment to satisfy a number of requirements and requests focused on mitigating environmental impacts and reducing cost. To a large degree this effort has been successful. The stated BRT goals have been achieved over the Core Tunnel Segment, which comprises a large portion of the alignment. For Phase III, the remaining challenge is to identify the preferred alignment between the Boylston Silver Line Station and a portal to grade. As discussed and described elsewhere, four alternatives remain under consideration; Tremont Street, Charles Street or Stuart Street to a NEMC portal and Columbus Avenue to a Columbus Avenue portal. For all four alternatives the Boylston Station platforms are proposed in the same location (although in the Tremont Street alignment the platforms vary in configuration). In three alternatives the portal is proposed in the same location, NEMC. In the fourth alternative a portal is located within the limits of Columbus Avenue, between Arlington and Berkeley Streets.

A particular set of issues arise with the three alignments (Tremont, Charles and Stuart) terminating at the NEMC portal, from the perspective of BRT operations and system performance. Any alignment between Boylston Station and the NEMC portal faces a design challenge with the curvilinear geometry and the vertical gradients near the acceptable limits. The following considerations affect the NEMC portal alignments being evaluated:

- The **relative location** of the Boylston platforms and the NEMC portal. The station is westerly of the portal, which in turn is the 'westernmost' point of entry to the tunnel. This apparent 'backtracking' is a result of the need to achieve two goals: connecting to the Green Line at Boylston Station and connecting to Phase I Washington Street service.

- The **short distance** between stops at Boylston Station and the surface station at the NEMC portal. Over this distance the vehicle is unlikely to utilize its full acceleration or speed. The number of curves required to complete each of the NEMC alignment routes has a direct effect on the straight sections of the alignments, hindering the vehicles' ability to maintain and achieve optimum speed.

Because the Boylston Silver Line Station is west of the NEMC portal, a number of turns need to be introduced into the alignment. The number of turns in each alignment is a function of the route followed between the two points; the proposed tunnels follow public ROW of city streets to the

[1] Levinson et al. *Bus Rapid Transit- Implementation Guidelines*, TCRP Report 90, Volume II.

largest extent practicable, in order to minimize impacts to private property and reduce costs. The Charles Street alignment departs from the street ROW at Elliot Norton Park, and all three alignments traverse the Boston Redevelopment Authority (BRA) parcel and Doubletree Hotel site.

By comparison, the Columbus Avenue Alternative has a straight alignment, without tight turns that would negatively affect optimum speeds or give rise to other operational concerns. The tunnel continues in a westerly direction beyond Boylston Station under existing streets to the portal between Arlington and Berkeley Streets, west of the station.

Refer to Table 7.3-1 for a comparative evaluation of the four alignment alternatives on a variety of attributes.

As can be seen from the data presented in Table 7.3-1, all three of the NEMC portal alignments are characterized by a large number of short radii curves over a short length of tunnel. The Tremont Street alternative includes the turnaround loop in the revenue portion of the alignment accounting for one of the tight radius curves and 230 degrees of curvature. In addition, there are two short radii curves of approximately 90 degrees of curvature: one entering Tremont Street from Boylston Street, and one departing Tremont Street to the portal. These 90 degree bends occur at opposite ends of a segment with a slope of 6 percent.

The Stuart Street Alternative is comprised of a series of short radii curves (60 feet to 80 feet) of approximately 90 to 115 degrees of curvature each, comprising an “S-curve” from Boylston Street to the portal. The Stuart Street “S-curve” alignment is further characterized by short tangent lengths between curves and by a 4 percent slope.

The Charles Street Alternative is comprised of two curves of roughly 90 degrees. One is similar to the Stuart Street Alternative, located at Boylston and Charles Streets. The other, located at the departure from Charles Street to the Elliot Norton Park, is a larger radius curve than any of the three curves in the Stuart Street Alternative. The Charles Street Alternative also has an effective tangent of 880 feet from Boylston to the Elliot Norton Park turnout, compared to the tangent segments of 330 to 350 feet in the Stuart Street alignment. (Tangent length is a controlling factor in attaining optimum running speeds, with longer tangents being preferred.) The 880 foot tangent is on a 4.8 percent slope.

The Columbus Avenue Alternative is a rather straight alignment, with one curve radius of 300 feet or less and an effective tangent length of 1,800 feet. Slopes are 1 percent outbound and 6 percent inbound. As noted above, the maximum attainable speed for each alignment is a function of the number of curves and their degree of curvature. The top speed achievable for the Columbus and Charles Alternatives is 25 miles per hour, versus 15 miles per hour for the Tremont and Stuart Alternatives.

Beyond the achievement of reasonable quality BRT characteristics in the tunnel environment, best achieved in the Charles Street and Columbus Avenue alternatives, the travel time on the surface street running sections of each of the alignments is also a factor to be considered in the evaluation of the Build Alternatives.

Under any of the Build Alternatives, Dudley service would include routes entering the portal providing access to the Core Tunnel Segment stations, the South Boston Waterfront and Logan Airport. Surface service on Washington Street would continue to serve Temple Place to meet the demand for direct service to Downtown Crossing. According to a Central Transportation Planning Staff (CTPS) survey, 70 percent of current Silver Line Phase I riders are destined for downtown. This route would operate on a six-minute headway for all the Build Alternatives.

Table 7.3-1 – Summary of Alignment Characteristics

	Alignment Characteristic							
Alignment	**Total Length of Travel [1] (ft)**	**No. of Curves (ea)**	**No. of Curves with Radius less than or equal to 100' (ea)**	**No. of Curves with Radius greater than 100' and less than or equal to 300' (ea)**	**Total Curvature (deg) [2]**	**Average Speed (mph)**	**Running Time [3] Boylston Station to portal (min:sec)**	**Running Time [3] Boylston Station to E. Berkeley/ Washington [5] (min:sec)**
Tremont Street	3,030	7	3	2	484	7.6	4:33	6:03
Charles Street	2,275	5	2	1	246	10.3	2:31	4:01
Stuart Street [4]	2,430	6	5	1	409	8.2	3:23	4:53
Columbus Avenue	2,175	3	0	1	82	12.0	2:05	4:35 inbound 5:35 outbound

Notes:

1. Boylston Station to portal.
2. Total Curvature is the sum of the angular deflection of the angles in each alignment. For reference, a right angle turn has a "curvature" of 90 degrees.
3. Exclusive of mode change and dwell time.
4. Stuart Street utilizes 50' spiral lengths versus recommended 100' spiral lengths, in all curves.
5. The East Berkeley Street/Washington Street intersection represents a common point for all four alignments. A comparison of running times between Boylston Station and this intersection allows for comparison of all Build Alternatives for an equivalent route. Additionally, all travel times from Dudley to this intersection as well as from Boylston to World Trade Center are identical for each alternative.
6. Two curves comprise the right angle turn at Boylston/Charles Streets.

The quality of the Silver Line Phase I ride on Washington Street to Temple Place is reasonable today, with the primary problem on the route encountered at the Stuart Street/Washington Street intersection.[2] The Tremont Street and Stuart Street alternatives require cut-and-cover construction at the Tremont Street and Stuart Street intersection causing disruption to the existing Silver Line I service and substantially exacerbating the existing Stuart Street problem. This disruption is totally avoided by either the Charles Street or the Columbus Avenue alternatives, further reinforcing the operational superiority of those two routes.

After completion of Silver Line Phase III, the option exists to re-route the remaining outbound Temple Place to Dudley service from the problematic Stuart Street portion of the current route to continue on Tremont Street and Oak Street instead, where it would rejoin the current Washington Street alignment, thus improving the running time and reliability of the service.

For the Columbus Avenue portal alternative, the inbound route from Dudley would access the portal via East Berkeley and Berkeley Streets, with a right into the portal. Outbound service would exit the portal and turn right on Berkeley Street, right on Stuart Street, and right on Arlington Street to Herald Street, where it would turn right onto Washington Street. While East Berkeley and Berkeley Streets would not have dedicated BRT lanes, traffic flow is reasonable and the route direct, providing a one-seat ride from Dudley to Back Bay. However, the outbound route with three right-turns is indirect, adding about a minute of travel time to the outbound route. Discussions are underway with the City of Boston to explore a more direct alternative, with outbound routes using a contraflow lane on Berkeley Street to Chandler Street, where a bus-only lane would provide more direct access to Herald Street at the Tremont Street intersection. Other options might include a contraflow lane on Berkeley Street to Tremont Street, or all the way to Washington Street via East Berkeley Street. Any of these would improve the directness of the route and provide the potential of an added stop serving the Tremont Street/East Berkeley Street area.

The service from the NEMC portal to Back Bay would involve taking a right on Washington Street, a right on Oak Street, a right on Charles Street, a left on St James Avenue, a long straight run to Huntington Avenue, right at West Newton, and right on Dalton. It would return via Boylston, right on Exeter, left on Stuart, right on Arlington to Herald, and left on Washington to the portal. While most of the Back Bay service would be on city streets without special lanes, most of these streets have reasonable traffic characteristics, and are served by MBTA buses. The service to Back Bay from the Columbus Avenue portal involves less street running distance, and avoids the NEMC portal to Washington to Oak to Charles series of right turns.

The Stuart and Tremont alternatives would require a longer travel time than either the Charles Street or Columbus Avenue alternatives due to reduced travel speeds in the tunnel, and therefore are the least attractive alternatives from a travel time perspective. Comparing the two portals, the NEMC portal provides more direct service to Roxbury and less direct service to Back Bay, while the Columbus Avenue portal provides less direct service to Roxbury and more direct service to Back Bay. However, the total running time for service between Boylston Station and Washington Street at East Berkeley Street (the common point for all Build Alternatives) for the Charles Street and Columbus Avenue alternatives is comparable, at 4 minutes:1 second and 4 minutes:35 seconds (inbound route) respectively. The slightly longer surface travel time from the portal to Washington Street for the Columbus Avenue alternative (1 minute:30 seconds) is balanced by a quicker travel time in the tunnel. (See Table 7.3-1.) The outbound travel time for the Columbus Avenue alternative is slightly longer at 5 minutes: 35 seconds. The MBTA is working with the City of Boston to develop an alternative route with a contraflow lane on Berkeley Street to improve the outbound travel time.

[2] Stuart Street becomes Kneeland Street east of Washington Street.

7.3.2 System Performance Characteristics

7.3.2.1 Identity and Image

The Silver Line BRT aims to provide first-class transit service on a par with light rail transit (LRT). The evolution of BRT as a transit mode provides the opportunity for each new system or system upgrade to add to or refine the definition of just what characterizes BRT. Planners are cognizant not only of the operating parameters but the perceptions of the users of the system. Avoiding a passenger perception that BRT is a 'second-class' transit mode is an important objective. In a group of potential alignments considered 'less than desirable' improvements at the margins of the design could make the difference in the experience and perception of the individual rider and the operating performance of the entire system.

Some of the distinguishing attributes of a BRT system include their **permanence, travel time, reliability,** and **ease of use/ride comfort.**

7.3.2.2 Permanence

The MBTA in its development of the Silver Line has committed to a permanent facility by its investment in branding the line, the construction of tunnels and stations for Phase II service, dedicated lanes and signature stops on Washington Street for Phase I service, and vehicle selection. All four Build Alternatives would maintain the high standard that MBTA has set for the service.

7.3.2.3 Travel Time

Travel times are dictated by the geometric alignment: vertical gradient, number of horizontal curves, degrees of curvature (also deflection angle) per curve and total degrees of curvature in route, distribution of curves over the whole segment and sight distance, all of which in turn impact the speeds that are achievable along the portal alignment section of the tunnel as well as the length of travel. Although the differences in length are relatively small among the Build Alternatives, even over a short distance these differences can account for noticeable differences in time. Moreover, due to the frequency of service and high ridership, small differences in travel time affect a large number of passengers as well as system operating costs.

Engineering preference and judgment favor the longest-radius curves possible in affecting change of direction in a transit system, for a number of reasons. Tighter-radius curves create the need for speed restrictions, and result in increased vehicle wear and increased maintenance (in the case of LRT, increased wheel 'squeal' adds to environmental noise impacts to riders, transit workers and the neighborhood). Each of the NEMC portal alignments has tight curve radii. The differences are in the size of the radii (a larger radius is preferable), and the number and distribution of curves along the alignment.

The Charles Street alignment is preferable to the other NEMC portal alternatives; it has the fewest curves with greater radii, and they are distributed to provide a tangent segment of reasonable length, permitting the vehicles to operate at or close to design speeds.

In the Tremont Street alignment, a pair of short-radius 90 degree reverse curves occur at opposite ends of the Tremont Street segment. In addition, the inbound travel-way crosses the outbound travel-way at the same grade. Vehicles would have to come to a complete stop and wait for a clear signal before proceeding and entering the Boylston bypass lane. This would have a clearly deleterious impact on travel time.

In the Stuart Street alignment, a series of short-radius 90 degree curves limit the speed over most of the segment to the low speed permitted through the curves. This is due to the combination of short tangent lengths between curves and the requirement that the entire vehicle travel through the curve at the reduced speed (front end entering, rear end departing). Under these conditions

the vehicle cannot pickup speed since by the time the rear of the vehicle clears the curve the front end is on the approach to the next curve. Otherwise, there would be constant accelerating / decelerating that would be impractical and uncomfortable for riders.

The Columbus Avenue alignment by comparison, is a straight alignment with only one curve of 107 foot radius proximate to the Boylston Station platform. The balance of the alignment is effectively a tangent rising to grade.

7.3.2.4 Reliability

Passenger surveys indicate service reliability is important to attracting and retaining passengers. All other aspects of reliability being comparable, the distinguishing feature of these alignments affecting reliability is the geometry of the alignment.

One key area of service reliability is maintaining contact between the overhead power cable and the vehicle 'trolley pole'. This physical connection is made at the entrance to the tunnel at either end, through a system designed to catch the raised trolley pole and guide it onto the cable. Contact is maintained by a concave fitting at the end of the pole, and pressure is induced by a mechanical system used to raise the pole.

Opportunities for vehicle de-wiring (i.e., accidental disengagement of a trolley pole from the overhead wire) increase as curve radii decrease. Should a failure occur, the operator would need to park the vehicle, walk to the rear, and manually re-wire the vehicle. The latter operation could place the driver and passengers at risk if it is stopped in a blind section of the tunnel. Given the high volumes of vehicle through-put in the system, such breakdowns would have ripple effects in causing delays throughout the system.

To offset this risk of pole disengagement, vehicles must travel at a lower speed through tight radius segments of the alignment, corresponding to lower vehicle speeds and higher travel times for passengers. As this runs contrary to the objectives of BRT, alignments that reduce or eliminate the need for tight-radius curves are preferable.

In addition, an increased likelihood and incidence of curb and wall scrapes resulting in tire failure and damaged mirrors or other physical damage will cause a shutdown in the service due either to an inability to move the vehicle or the need to await an inspection before proceeding in the case of a minor incident. Accident data implies that curvilinear alignments have an increased likelihood of these occurrences.

Among the Build Alternatives, the Columbus Avenue alignment has the fewest curves and the best quality performance under this criterion, followed by the Charles Street alignment.

7.3.2.5 Ease of Use/Ride Comfort

While passenger comfort is an intangible factor, passengers who feel that the Silver Line offers a level of speed and comfort that is below their expectations for a rapid transit service may avoid using the system and the Silver Line will fail to realize the full potential of BRT and the substantial investment to create an exclusive subsurface travelway.

Ridership analyses show that during peak periods, the Silver Line will carry a significant number of "standee" passengers. Because of the geometrics of the Stuart Street and Tremont Street alternatives (S-curve in the former and revenue service through the turnaround loop, coupled with an S-curve in the case of the latter), standees may find the ride objectionable. The roadway super-elevation (i.e., banking) is based on design speeds that direct forces due to lateral acceleration to the roadway surface and vehicle floor to minimize the sensation that passengers are being thrust sideways. Actual operating speeds are likely to be less and the result is the perceived difference between the actual lateral acceleration forces and gravity. All Boylston to NEMC portal alignments are less than desirable in this regard; the degree of acceptability for

each is related directly to the number, radii, and distance between curves on the respective alignment. To maintain the MBTA's criteria for lateral acceleration, and in consideration of passenger comfort, the Silver Line may have to operate on each of the NEMC portal alignments at reduced speeds in tight radius curves, compromising the speed and efficiency of the system. The Tremont and Stuart Street Alternatives would more likely operate at lower speeds than the Charles Street Alternative, making it the least objectionable of the three NEMC portal alternatives with respect to this factor. Columbus Avenue, being a straight alignment, is the most acceptable of the Build Alternatives with regard to the underground segment of the alignment.

7.3.2.6 Safety and Security

Passenger and worker safety are of paramount concern to the MBTA. In planning transit systems this concern is reflected in opting for those alignments that provide for the safer operation of the alternatives available.

During preliminary design of the Silver Line Phase II, the MBTA revised the system alignment between Atlantic Avenue (at the CA/T Vent Building No. 3) and the east side of Fort Point Channel (at Seaport Boulevard/Sleeper Street). The alignment had an undesirable S-curve (comprised of 150 and 300 foot radii curves) in combination with a steep gradient (6 percent). The revised alignment consisted of one 250 foot radius curve that utilized a flatter slope (3 percent). Studies conducted at the time, looking at mechanical failure rates alone, determined that the S-curve alignment was significantly more likely to experience a catastrophic incident than the alternative which was ultimately constructed. The final alignment required the construction of the tunnel beneath the historic Russia Wharf block of buildings which led to permanent ROW costs and additional construction costs in order to construct the safer alignment.

Alignments with fewer curves, less severe curves, and smaller slopes are inherently safer alignments. Ample data are available to suggest that this is the case whether incidents occur as a result of mechanical failure or operator error.

Straighter alignments also reduce operator fatigue, improving the safety of the Silver Line and reducing the chance of human error accidents. At present, it is not anticipated that the Silver Line will have a lateral vehicle guidance system. Phase II has commenced operation without one. Absent a guidance system, the skills of the vehicle operator to steer the vehicle are relied upon solely. It is likely that a guidance system would be warranted in the case of the Stuart Street tunnel in order to reduce driver fatigue and the chance of tunnel wall scrapes or more severe incidents in tight radius turns. This requirement would impact system capital and maintenance costs, require retrofit of existing Silver Line vehicles, and impose further special requirements on all Silver Line vehicle procurements into the future.

Under the safety and security criterion, Columbus Avenue, being a straight alignment, is the most acceptable of the Build Alternatives, followed by Charles Street among the three NEMC Alternatives.

7.3.2.7 Operating Cost

For a given level of service, system operating costs are determined by the grade, curvature, and length of the alignment. Steeper upgrades require power consumption (and potentially greater power generation and transmission capacity), while steep downgrades require heavier braking and greater wear and tear on the vehicle. These grades also affect the lifespan of vehicle drive-trains, such as transmissions and motors. Similarly, tight radii curves exacerbate braking needs and increase wear on vehicle suspensions. As the length of the alignment increases, vehicle miles traveled also increase, causing general wear and tear and increased power consumption. Ideally, the preferred alignment is level and straight (the most critical factors), with additional preference given to shorter alignments. For the reasons stated above, the Columbus Avenue alignment best meets these characteristics, followed by the Charles Street alignment.

7.3.2.8 Future Light Rail Transit Operations

The MBTA has undertaken the design of the Silver Line tunnels for use in BRT operations, with a commitment to do so without precluding the future operation of LRT in the same tunnels. While it is not known when such a conversion of use would occur, LRT conversion is another criterion to use in evaluating the alternatives.

The MBTA Green Line, an LRT service, employs curves under 100 foot radius in a number of locations. These locations are the source of the MBTA experience with rail wear, wheel wear, frequent track replacements, wheel 'squeal', and derailments. The locations in the Green Line system occur as tight radii on level or slightly sloping vertical gradients.

Of the alignments under evaluation, the Stuart Street and Tremont Street alignments are considered extreme with regard to LRT standards in the combination of tight radius curves and steep grades. Radii of less than 100 feet require double guardrail, that is restraining rail is installed on both the outer and inner running rails. This poses several maintenance issues related to replacement of rail in these instances. The frequency of rail replacement is greater due to the additional forces imparted in the curve. The time required to disassemble and reassemble the track is longer due to reduced access to bolted connections and the number of rails (running and restraining) involved. The combination of tight radius curvature and steep grades proposed in the Stuart Street alignment would be unique in the MBTA system.

Another consideration is the ability of maintenance equipment to travel the ROW. Existing maintenance equipment used on the Green Line is unable to traverse the Park Street Loop radius at approximately 50 feet. In that location there are parallel tracks that allow maintenance equipment to bypass this area. The Stuart Street segment does not have a similar parallel route nor is a feasible option for one readily apparent given the desire to remain within the public ROW.

Due to reduced vehicle speed in the tight radius curves, the Stuart Street and Tremont Street alignments have longer run times than the Charles Street alignment. This is a significant difference (33% longer) on such a short distance.

7.3.3 Conclusion

Fully grade separated, segregated BRT running (travel) ways have highest cost and, typically, the highest level of performance with respect to speed, safety and reliability. The MBTA is making an investment to achieve this performance to garner the best return on that investment. As shown in this discussion of BRT performance criteria, the challenge of achieving the various objectives of connectivity, ROW taking avoidance and high performance is a difficult one.

The Columbus Avenue alignment performs the most favorably against the criteria presented in this section. It features larger turning radii, higher running speeds, and favorable safety, operating, and LRT conversion characteristics.

Any of the three NEMC portal alignments offers a workable solution. At the same time none are as desirable as the MBTA would prefer on technical merits. All the variables considered in this discussion can be mitigated through introduction of alignment improvements. The best available alignment of the three NEMC portal alternatives in this case is the Charles Street alignment.

Based upon the foregoing analysis of BRT system objectives and MBTA design criteria, the Columbus Avenue and Charles Street/NEMC alignments best meet the BRT performance criteria.

7.4 Summary of Environmental Impacts

The Silver Line Phase III Core Tunnel Segment and alignment alternatives have been planned to minimize impacts by providing a tunnel design that is within the right-of-way of major streets.

This section summarizes impacts associated with the Baseline Alternative, as well as the potential environmental impacts and proposed mitigation measures associated with the Build Alternatives so that they may be compared. The No-Build Alternative provides the basis against which the impacts of the other alternatives are compared. (See Chapter 4 for a discussion of existing conditions which define the impacts associated with the No-Build Alternative. See Chapter 5 for a full discussion of permanent impacts associated with the Baseline and Build Alternatives, and Chapter 6 for a full discussion of construction period impacts.) A comparative summary of the environmental impacts and proposed mitigation associated with the Core Tunnel Segment and alignment alternatives is provided in Table 7.4-1.

7.4.1 Baseline Alternative

As discussed in Section 7.5 below, the Baseline Alternative is required by FTA as part of its New Starts rating process. Compared with the No-Build Alternative, the Baseline Alternative would increase the frequency of the Phase I and II service to a level consistent with that proposed for the Build Alternatives and create a new Back Bay to Temple Place bus route that would run on a 10-minute headway. To achieve this increased frequency, three vehicles per hour would be added in each direction to Washington Street for Phase I service. The addition of these vehicles to an existing urban street is not anticipated to result in any measurable increase in traffic, air quality, noise, or vibration impacts compared to future No-Build conditions. The increase in Phase II frequency would occur entirely within the existing Phase II tunnel and therefore would not result in traffic, air quality, noise, and vibration impacts to the community. There are no other short-term or long-term impacts associated with the Baseline Alternative. Therefore, for purposes of the evaluation in this chapter the No-Build and Baseline Alternatives are treated as indistinguishable.

7.4.2 Build Alternatives – Long-term (Permanent) Environmental Impacts

Given that the major portion of the alignment for any of the Build Alternatives is underground in a tunnel, there are relatively few long-term impacts associated with any of the Build Alternatives. Impacts are predominantly associated with the proposed portal locations (NEMC or Columbus Avenue), where the tunnel alignment interfaces with the surface. The following section provides a discussion of the key long-term environmental impact issues, as articulated through the public participation process. A summary of the permanent environmental impacts discussed in Chapter 5 is provided in Table 7.4-1. Section 7.4.3 summarizes the construction phase impacts discussed in Chapter 6.

7.4.2.1 Impacts of the Core Tunnel Segment

The Core Tunnel Segment, which is common to all Build Alternatives, is a modification of the previously approved full build Transitway alignment (see Chapter 2). It would result in minimal long-term impacts, since most of the structures (tunnels and stations) are located entirely underground within existing street ROW. Since Silver Line operations within the Core Tunnel Segment will be entirely underground, there are no permanent traffic impacts associated with this segment. Rather, enhancement of the transportation infrastructure will provide a benefit to the existing and future land uses in the corridor, by increasing transportation access and mode choice.

The potential for impacts for the Core Tunnel Segment is largely associated with those project elements that interface with the surface at station areas: the structures associated with passenger access, emergency egress and ventilation. (See Table 7.4-1.) By relocating the turnaround loop to the intersection of Boylston and Charles Streets, the Core Tunnel Segment avoids the extensive construction on and under the Boston Common that would have been required under the 1993 Transitway FEIS/EIR alignment. This modification is consistent with the intent of Section 4(f) of the Department of Transportation Act of 1966 (see Section 5.10), to minimize harm to cultural resources and public parks. The MBTA and FTA will develop a Section 106 Consultation Programmatic Agreement for cultural resources within the preferred alternative's

Area of Potential Effect (APE) with the Massachusetts State Historic Preservation Office (Massachusetts Historical Commission), the Wampanoag Tribal Historic Preservation Officer, the Boston Landmarks Commission, and other appropriate city agencies, and other interested parties that may be identified. The MBTA will continue to work with these agencies as the design progresses to ensure compatibility of Silver Line project elements with the identified significant and National Register eligible historic and archaeological resources. The Programmatic Agreement will also address the accessibility and fire code requirements related to the existing Green Line station area on the Boston Common.[3]

7.4.2.2 Tremont, Charles and Stuart Street Alignments/NEMC Portal Issues

The NEMC portal, located between the NEMC garage and the Doubletree Hotel, is associated with the Tremont Street, Charles Street and Stuart Street alignment alternatives. The principal long-term impact issues associated with the NEMC portal include traffic and pedestrian safety, groundwater, and potential noise and vibration impacts to NEMC operations. (For discussion of long-term impacts on historic resources caused during construction, see Section 7.4.3 below.)

Currently approximately 15 Silver Line Phase I vehicles travel on Washington Street in each direction during the peak hour, with an on-street stop near the main entrance of the New England Medical Center. With any of the Build Alternatives using the NEMC portal, the majority of the inbound Silver Line vehicles (18 per hour in the peak hour) would turn left prior to the crosswalk at the NEMC main entrance and discharge passengers at an off-street stop within the portal boat section, before entering the tunnel. Outbound vehicles would turn right onto Washington Street after picking up passengers at the portal stop, similarly avoiding the NEMC crosswalk. While overall there is more service under Phase III, there would be fewer Silver Line vehicles on Washington Street in the area of the NEMC crosswalk, as only the Dudley to Temple Place service would remain on the surface, with a frequency of 10 buses per hour during the peak period (compared with 15 buses per hour under current peak period conditions).

Traffic and Pedestrian Safety

Traffic impact analysis indicates that the Silver Line Phase III project would have a negligible impact to travel times, capacity and congestion within the Washington Street corridor in the NEMC portal area. The most congested intersection within the corridor, Washington Street/ Kneeland Street, would experience a slight improvement. This improvement would occur because some of the Silver Line vehicles that currently operate on the surface along Washington Street would instead enter the Phase III tunnel at the NEMC portal, reducing bus volumes at the Kneeland Street intersection.

Concern has been raised regarding potential conflicts between inbound Silver Line vehicles turning to enter the portal and southbound ambulances accessing the NEMC emergency entrance on Nassau Street, opposite the portal. A dedicated 11-foot left-turn lane would be provided along Washington Street for the Silver Line vehicle to facilitate access to the portal. This left-turn would be integrated in the Washington Street design in order to avoid the blockage of the emergency entrance to NEMC at Nassau Street. (See Figure 5.3-1a) An inbound Silver Line vehicle on Washington Street would utilize this bus-only left-turn lane to wait for an opening in southbound Washington Street traffic before turning left to enter the portal.

An analysis of the available gaps in traffic of sufficient duration to allow a vehicle in the opposing lane to make a turn was conducted to determine the potential impact on emergency vehicle access. A gap of six seconds is required for ambulances to make a left-turn. Since the Silver Line vehicles are longer, they would require a gap of 10 seconds to make a left turn. The “gap”

[3] These alterations to the Green Line for the purposes of Americans with Disabilities Act (ADA) and National Fire Protection Association (NFPA) compliance are identical in all alternatives. No alternative results in different or greater impacts on the Boston Common.

analysis identified the number of vehicles on Washington Street southbound making a left turn into Nassau Street: 30 (including four ambulances) during the morning peak hours and 18 (including two ambulances) during the evening peak hours. These vehicle numbers are considerably less than the number of effective gaps: 140 and 136 in the morning and evening peak hour respectively. Similarly, the number of Silver Line vehicles traveling northbound on Washington Street (a total of 28 with 18 turning left into portal, and 10 continuing to the surface to Temple Place) during the peak hour is considerably less than the number of available gaps of six seconds or more (69 in the morning peak and 52 in the evening peak). Therefore, the gap analysis shows that there is sufficient access for emergency vehicles, and that the NEMC portal would not impede emergency access to the hospital. (See Section 5.3 for additional discussion and Figure 5.3-1b).

The NEMC portal is located to the south of a number of important pedestrian destinations, including the NEMC and the Orange Line station. The project design would incorporate measures to improve pedestrian safety as determined by an urban design study. Sidewalks on the west side of Washington Street in the vicinity of the portal would be widened, and improvements such as pavement markings, bollards, signs, and audible warning devices such as those used on parking garage exits would be installed in the vicinity of the portal driveway to enhance pedestrian safety.

Noise and Vibration

Silver Line Phase III will operate rubber-tired vehicles, with the majority of the vehicles operating in the Core Tunnel Segment. The noise analysis conducted in accordance with the *FTA Transit Noise and Vibration Assessment Manual* indicates that based on FTA noise criteria, there would be no impact to the noise-sensitive receptors in the vicinity of the NEMC portal during operation of Silver Line Phase III. Noise sensitive receptors include the Doubletree Hotel, NEMC, residences on Lyndeboro Place, South Cove Plaza Residences, and Elliot Norton Park. (Construction phase impacts are discussed separately in Section 7.4.3 below.) No vibration impacts are anticipated from operation of the project based on the FTA's Vibration Screening Procedure.

A detailed analysis of potential vibration impacts at the Tufts NEMC facility indicated that vibration levels from proposed Silver Line vehicle operations as well as construction at the NEMC portal would be below allowable vibration levels for sensitive equipment in the clinical labs, operating suite, and MRI unit.

Groundwater

Groundwater management is an important concern to be addressed by Silver Line Phase III, particularly in areas formed by landfill, such as occurs along the Columbus Avenue alignment and the Charles Street alignment. The decay and rot of timber piles due to lowered groundwater levels has been an on-going problem, particularly in the Back Bay, South End and Bay Village neighborhoods of Boston.

The original land mass of colonial-era Boston is located on what is known as the Shawmut Peninsula. Charles Street is the approximate western boundary of this original land mass. The Tremont Street alignment is located within the area of the original Shawmut Peninsula, and the Stuart Street alternative appears to be primarily located within the Shawmut Peninsula. Therefore there is less potential for these alternatives to encounter areas formed by landfill. The Charles Street alignment however, is located on the edge of the Shawmut Peninsula and therefore has a greater potential to encounter groundwater in the area.

To address the issue of groundwater levels, the MBTA will install observation wells along the preferred portal alignment to provide a means to collect groundwater data before and during construction, and to monitor groundwater levels on a regular basis after construction has been completed. The MBTA will coordinate with the Boston Groundwater Trust on the location of the

monitoring wells. Upon completion of the project, the MBTA will turn over control of the wells to the Trust.

The tunnel will be designed and constructed to eliminate any free water leakage and to minimize and mitigate seepage to the maximum extent feasible. Typical post-construction seepage rates through tunnel walls are projected at approximately 1 gallon per minute per 1,000 linear feet of tunnel. Three general waterproofing methods will be used to minimize and mitigate seepage: waterproofing membrane around mined tunnels; waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls; and, special detailing at the connection of mined tunnels to tunnels constructed inside slurry walls (cut-and-cover sections). Based on these proposed design and construction methods, no significant permanent groundwater impacts are anticipated from this alternative.

7.4.2.3 Columbus Avenue Alignment/ Portal Issues

The Columbus Avenue portal is associated with the Columbus Avenue Alternative. Implementation of this Build Alternative would result in the elimination of the westbound travel lanes on Columbus Avenue between Arlington and Berkeley Streets. Inbound Silver Line vehicles originating in Dudley (12 in the peak hours) would use East Berkeley and Berkeley Streets to access the portal. Outbound Dudley service would use Berkeley, Stuart, Arlington and Herald Streets to access Washington Street. Inbound Back Bay service would use Columbus Avenue to access the portal; the outbound service would use Berkeley Street and St. James Avenue to initiate the outbound Back Bay route. The principal long-term impact issues associated with the Columbus Avenue portal are traffic and potential groundwater impacts.

Traffic

Berkeley Street at the Columbus Avenue intersection is projected to carry approximately 1,464 vehicles in the morning peak hour in 2013, slightly more than the 1,328 vehicles in the evening peak hour. The 12 Silver Line vehicles per hour that would use Berkeley Street (which is already an established MBTA bus route) represent an increase in traffic volume of less than 0.1 percent. While there would be minor changes in delay at this intersection, it would still continue to operate the same LOS (D) as it would under the 2013 No-Build condition, which is considered acceptable for an urban situation.

The location of the portal on Columbus Avenue and the proposed Silver Line operations are not anticipated to substantially affect operations at the Boston Fire Department station located on the corner of Columbus Avenue and Isabella Street. There is an adequate turning radius in either direction to accommodate the largest piece of fire equipment at the station. The current fire pre-empt signal would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue.

The closure of the westbound travel lanes on Columbus Avenue between Arlington and Berkeley would divert westbound traffic originating in Park Plaza to St. James Avenue and Clarendon Street, where it would rejoin Columbus Avenue. This diversion is expected to increase traffic on Park Plaza/St. James Avenue and on Clarendon Street between St. James Avenue and Columbus Avenue by approximately 350 to 400 vehicles in the peak hour. While this would result in some additional delay at the corresponding intersections, they would continue to operate at an acceptable LOS of D or better, except for the St. James Avenue/Clarendon Street intersection that would operate at an evening peak hour LOS of E.

In addition, approximately 110 vehicles in the evening peak hour currently make a U-turn from Stuart Street onto Columbus Avenue westbound. Under the Columbus Avenue Alternative, this move would be eliminated. Vehicles making this move would either have to travel east, turning left at Charles Street and Park Plaza to continue their westbound travel, or they would turn right on Arlington, Cortes, and Berkeley Streets, with a left-turn on Columbus Avenue to continue westbound. The traffic analysis conducted for the SDEIS/EIR assumed that the vehicles would

choose to turn right at Arlington Street. This will add approximately 110 vehicles to Cortes Street (which is one-way westbound) during the evening peak hour, approximately the same number of vehicles that are anticipated being removed from the street as a result of removal of the access from Marginal Street from improvements proposed by the Columbus Center project. The intersection of Berkeley and Cortes Street would operate at LOS of B, both with and without the implementation of the Columbus Avenue alternative. No increase in traffic is anticipated on Isabella Street, which is one-way in the eastbound direction.

The intersection of Arlington/Stuart/Columbus would improve under the Build Alternative. This intersection has had a consistently high accident rate and a poor level of service (LOS E in the morning peak hour and LOS F in the evening peak hour). The closure of westbound Columbus Avenue would eliminate one of the moves at this intersection and improve the LOS to D in the morning peak, and LOS E in the evening peak hour. It also would provide an opportunity to improve pedestrian and vehicular safety at the intersection through roadway layout and signal phasing improvements.

Groundwater

As described previously, groundwater management is an important concern in the Back Bay, South End and Bay Village neighborhoods of Boston. Specific design and construction methods would need to be employed along the Columbus Avenue alignment to minimize and mitigate the potential of effects of lowered groundwater levels.

To address the issue of groundwater levels, the MBTA will install observation wells along the proposed portal alignment to provide a means to collect groundwater data before and during construction and to monitor groundwater levels on a regular basis after construction has been completed. The MBTA will coordinate with the Boston Groundwater Trust on the location of the monitoring wells. Upon completion of the project, the MBTA will turn over control of the wells to the Trust.

The tunnel will be designed and constructed to eliminate any free water leakage and to minimize and mitigate seepage to the maximum extent feasible. Typical post-construction seepage rates through tunnel walls are projected at approximately one gallon per minute per 1,000 linear feet of tunnel. Three general waterproofing methods will be used to minimize and mitigate seepage: waterproofing membrane around mined tunnels, waterproofing membranes for tunnel slabs and roofs in slurry wall sections, with grouting if needed in the slurry walls; and, special detailing at the connection of mined tunnels to tunnels constructed inside slurry walls (cut-and-cover sections). Based on these proposed design and construction methods, no significant permanent groundwater impacts are anticipated from this alternative.

7.4.3 Build Alternatives - Construction Period Environmental Impacts

The tunnel design for all Build Alternatives has been developed to avoid and minimize impacts during construction to the greatest extent feasible. The tunnels will be located within roadway rights-of-way below ground, and in some cases will be stacked to avoid adjacent structures and buildings. For the most part, construction of any of the Silver Line Phase III Build Alternatives would result in similar, temporary impacts, to be mitigated through implementation of a Comprehensive Construction Management Plan. However, the Tremont Street Alternative and the Stuart Street Alternative (Tremont Street section) present some unique construction issues, with the potential for more significant traffic, community, and historic resource impacts than the Charles Street and Columbus Avenue Alternatives. The Charles Street Alternative would have greater construction period impacts on parkland than the other alternatives.

7.4.3.1 Core Tunnel Segment

The Core Tunnel Segment would be mined except for the station areas, and a section on Essex Street adjacent to the Phase II tunnel in Atlantic Avenue. A cut-and-cover method would be

employed for construction of Chinatown and Boylston Stations and the tunnel connection at Atlantic Avenue. Cut-and-cover sections will be stabilized with slurry walls, and covered over with decking to minimize impacts on the surface. Access will be maintained to business and residential buildings at all times. A Construction Management Plan (that incorporates the Section 106 Consultation Programmatic Agreement, stipulations for cultural resources) will be developed that will address all aspects of construction including potential impacts and mitigation commitments. The westbound travel lane of Boylston Street between Tremont and Charles Streets is proposed to be temporarily closed during construction and traffic diverted to Stuart Street. A construction staging area is proposed for the southwest corner of the Boston Common in the vicinity of the ball fields (see Figures 6.2-1 through 6.2-4). The proposed detour and staging area on the Boston Common would be subject to the approval of the Boston Transportation Department (BTD) and the Boston Parks and Recreation Department.

7.4.3.2 Tremont and Stuart Street Alternatives

These alternatives cannot be mined due to the presence of the existing Tremont Street subway tunnel, and therefore must be constructed by the cut-and-cover method. The existing tunnel is unsuitable for reuse as a Silver Line tunnel since it is too shallow to meet the proposed Silver Line Boylston and Chinatown Station elevations which would be located beneath the existing Green and Orange Line tunnel elevations respectively. Therefore this tunnel which is eligible for listing on the National Register of Historic Places, would need to be documented and demolished before the new Silver Line tunnels could be constructed. In addition, the 600 KV line within the existing tunnel that supplies power to the Green Line would need to be relocated prior to any demolition of the tunnel. This would require excavation and installation of a new 600 kV line in another utility corridor, resulting in additional impact and cost to the project.

Tremont Street is a southbound arterial through the heart of Boston's Theatre District. Cut-and-cover construction will require the closure of the parking lane on each side of Tremont Street and one travel lane, while maintaining two travel lanes at all times. This would cause disruption to traffic during the construction phase. Evening and nighttime construction is typically used to minimize this type of disruption. However, this approach could not be effectively used here, since much of the activity of the theaters along Tremont Street occurs during the evening hours. The cut-and-cover construction and demolition of the tunnel would also increase the potential for noise impacts until such time as the cut area was decked over, as well as vibration impacts as result of tunnel demolition.

7.4.3.3 Charles Street Alternative

Cut-and-cover construction through Elliot Norton Park for the Charles Street alignment would require that the park be entirely closed, and then rebuilt after construction has been completed. Use of the park would require an affirmative vote by two-thirds of the state legislature under Article 97 of the Constitution of the Commonwealth of Massachusetts, which protects public parks from being converted to other uses.

The north side of the park is bounded by historic residential structures on Lyndeboro Place that are in close proximity to the proposed tunnel alignment. Noise impacts would be expected at this location during the open cut construction. As a mitigation measure, a 12-foot high opaque privacy screen designed to attenuate dust, noise and views of construction would be erected.

7.4.3.4 Columbus Avenue Alternative

The Columbus Avenue Alternative would be mined from the turnaround loop to the end of Statler Park, east of Arlington Street. Cut-and-cover construction would occur through the Arlington Street intersection to the portal. Construction would be staged to maintain traffic flow through the intersection. Once the slurry walls were in place, decking would be installed to maintain traffic flow and minimize noise impacts from construction.

Table 7.4-1 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
Land Use	Underground Easements	None	5,200 sf	Approximately 12,000 sf under Elliot Norton Park.	6,120 square feet	None required.	Approximately 120 square feet directly in front of the Four Seasons Hotel.
	Surface-level impacts: (Potential impacts within street ROW are not listed here.)	None	**Boylston Station** Station access –1,000 sf easement within the Little Building, 74-94 Boylston Street Emergency egress structures: 200-250 sf on Boston Common, adjacent to the Deer Park Maintenance Yard 300 sf of easement within the Walker Building, 120-124 Boylston Street Green Line improvements – 2 elevators at 80-100 sf each and 2 emergency egress shafts at 250-300 sf each all on Boston Common **Chinatown Station** Emergency egress – 300 sf easement could be required within the basement level of the China Trade Building	Land Takings from the Portal: 17,440 sf owned by BRA 5,450 sf owned by the Doubletree Hotel The NEMC portal would not preclude future air-rights development above the portal by the BRA.			Access Impacts from the Portal: 155 Columbus Avenue (Salvation Army) – vehicular access from Columbus Avenue to the parking lot and service entrance would be impeded. 147 Columbus Avenue (Benjamin Franklin Smith Printers) – vehicular access to the loading dock on Columbus Avenue would be impeded; pedestrian access from Stuart Street would remain. 139 Columbus Avenue (Baptiste Yoga) - access to the entrance on Columbus Avenue would be impeded; pedestrian access from Stuart Street would remain. 135 Columbus Avenue (Flash's Cocktails) – vehicular access to the service entrance on Columbus Avenue would be impeded. The primary access to this business is from Stuart Street, which would be unaffected.
	Consistency with Local Plans	Not consistent with the region's long range transportation plan	Silver Line Phase III is a committed project in the region's long-range transportation plan. BRA policies, as expressed in specific plans and its ongoing development review process for the downtown and Waterfront area, encourage the strongest possible relation of development to transit. Silver Line Phase III would be supportive of these plans and policies by providing increased accessibility between key activity centers in the downtown core.				
	Mitigation		*Acquisitions of all real property and easements would be completed in accordance with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended and Part 24 of 49 CFR, as well as M.G.L. Chapter 79A and implementing regulations. All property owners would receive "just compensation" for an easement or fee acquisition of their property. The measure of just compensation is the fair market value of the property acquired at the time just prior to the taking. Any occupant found to be in place at the time of the acquisition would be considered eligible for relocation assistance in accordance with this Act. Relocation assistance measures include relocation advisory services and payments for moving and relocation costs. Relocation measures would be available to all business relocations without discrimination. (See Traffic and Parking for access impacts and mitigation).*				
Environmental Justice	Disproportionate Impacts/Potential Benefits	No impacts. Does not improve access between EJ communities and employment destinations.	Because the Silver Line would be primarily located under ground, there would be minimal impacts to nearby residents and no disproportionate impacts to EJ communities. Silver Line Phase III would benefit EJ communities, improving accessibility to jobs and other major destinations, as a result of travel time savings, improved level of service and greater convenience. It would also provide quicker and more convenient access to important employment destinations in downtown Boston and the Waterfront area.				
Traffic and Parking	Traffic – LOS Analysis Emergency Access	None	No traffic impacts.	No deterioration in LOS at any intersections Gap analysis indicates adequate capacity to accommodate turning Silver Line vehicles and ambulances.			• Improved LOS at the Arlington/ Stuart/ Columbus and Clarendon/Columbus intersection • Acceptable LOS at the Berkeley/ Columbus intersection. • Diversion of traffic to Park Plaza, St. James Avenue, and Clarendon Street with acceptable increase in delay • Deterioration in PM peak hour LOS at St. James/Clarendon intersection (D to E) • Diversion of approximately 110 vehicles to Cortes Street (PM peak hour) • Acceptable PM peak hour LOS at Berkeley/St. James intersection(B to C) and Clarendon/Stuart (C to D) • Adequate turning radius for fire equipment
	Mitigation		*None need*	• *An exclusive left-turn lane for Silver Line vehicles to be provided on Washington Street to manage access to the portal*			*Proposed intersection improvements at the Arlington/Columbus/Stuart intersection would*

Table 7.4-1 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
				• *Sidewalk and pedestrian safety measures to be installed in the vicinity of the portal.*			*improve LOS D and also improve traffic and pedestrian safety.* *The current fire pre-empt signal operation would be modified to ensure that fire trucks can effectively exit the station and travel in both directions on Columbus Avenue (westbound fire trucks will be allowed to utilize the available bus lanes).*
	Parking spaces/loading zones/service access lost	No impacts.	No impacts.	• 4 on-street parking spaces along the west side of Washington Street • Approximately 14 off-street parking spaces in the Double Tree Hotel lot • 80-spaces within the Auto-Parks off-street parking lot			12 on-street spaces, loading zones and 2 service driveways at B. Franklin Smith Printers (147 Columbus) and Baptiste Power Yoga (139 Columbus) along the north side of Columbus Avenue between Arlington and Berkeley Streets Metered parking spaces and Clarendon Street Tour Bus Stop along the north side of St. James Avenue between Arlington and Berkeley Streets – peak period only 2 to 3 metered parking spaces along the north side of Park Plaza east of Arlington Street 46 off-street parking spaces within the Salvation Army parking lot Elimination of 2 to 3 on-street parking spaces on Columbus Avenue for inbound Silver Line stop (Back Bay service).
	Mitigation		*None needed*	*No mitigation is required for the taking of the Auto Parks Parking Lot because it is leased from the BRA pending future development of the parcel. MBTA would work with Doubletree Hotel to reconfigure parking on the parcel to replace the 14 spaces lost, or provide replacement parking in nearby facilities.*			Access to off-street parking and loading docks from Columbus Avenue for the Salvation Army Headquarters Building (155 Columbus Avenue) and Benjamin Franklin Smith Printers (147 Columbus Avenue) that would be lost as a result of implementation of the Columbus Avenue Alternative would be replaced with a new access from Stuart Street. The one-story building at 320 Stuart Street would be removed to create an access to allow vehicles to enter the Salvation Army parking lot or to access delivery sites from Stuart Street. The proposed mitigation would allow for redevelopment of the parcel over the access drives.
Transit, Pedestrian and Bicycle		None	Increased pedestrian traffic would not negatively affect pedestrian LOS.				
	Mitigation			*Pavement markings, bollards, signs, lighting and audible warnings will combine to mitigate risks to pedestrians from transit operations. Sidewalks on the west side of Washington Street in the vicinity of the portal driveway opening are currently 13 feet wide and will be widened to 16 feet or more as a parking lane is being removed to increase pedestrian safety.* *A pedestrian crosswalk would be located at the portal entrance (West side of Washington Street) in order to facilitate pedestrian movement to and from the bus stop location (in the portal). Improvements to the crosswalk in front of the NEMC parking garage ramps will increase pedestrian safety. The roadway in front of the portal and parking garage exits could also be equipped with traffic calming features with the objective of encouraging lower vehicle speeds. Traffic calming features will have to be designed around the needs of emergency vehicles.* *An existing, non-accessible pedestrian path connecting Tremont Street to Washington Street through existing parking lots would be replaced with an accessible and lighted path along the side of the NEMC Parking Garage.*			*Improvement to the intersection and four street corners of the Columbus Avenue/Berkeley Street intersection would be installed to create a pedestrian-friendly environment. Contrasting pavements would be used through the intersection as a traffic calming measure and to increase driver awareness. Where bus stops are located on three of the five legs of the intersection, well-designed crosswalks, properly timed pedestrian signals, and clear signing would be installed for pedestrian safety and mobility.*

Table 7.4-1 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
Air Quality	Regional	None	Analysis of air quality at the regional and microscale level have indicated that all of the alternatives would result in a net benefit for regional air quality and not cause any air quality violations at the microscale level.				
	Micro-scale	None					
	Mitigation	*No air quality impacts; therefore no mitigation required.*					
Noise and Vibration	Project-wide/Historic	None	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts	No long-term noise and vibration impacts
	Vibration at NEMC facilities	None	Not applicable	A detailed analysis of potential vibration impacts at the Tufts NEMC facility indicated that vibration levels from proposed Silver Line vehicle operations as well as construction of the NEMC portal would be below allowable vibration levels for sensitive equipment in the clinical labs, operating suite and MRI unit.			Not applicable
	Mitigation	*No long-term noise or vibration impacts anticipated; therefore no mitigation required.*					
Geology and Groundwater		None	Excessive groundwater seepage not anticipated.				
	Mitigation		*Installation of monitoring wells. Design performance standards and waterproofing would minimize potential for seepage of groundwater.*				
Natural Resources	Wetland, flooding, navigable waterways, ecologically sensitive areas, endangered species, and water quality.	None	No impacts to natural resources.				
	Mitigation		*Water quality impacts would be minimized by the use of Best Management Practices and the design of the drainage system.*				
	Coastal Zones	None	Consistent with Massachusetts Coastal Zone Management (CZM) program policies.	Not within coastal zones.			
	Mitigation			*None needed*			
Cultural Resources	Archaeological	None	10 percent sensitive for significant sites: Native American fishweirs and camps; late 18th c. hemp house; 18th-19th c. domestic site; human burials associated with the Central Burying Ground on Boston Common	95 percent sensitive for significant sites: Native American fishweir and camp site(s); 18th-19th c. domestic/commercial structures and associated yard areas	20 percent sensitive for significant sites, but only in portal area (see common element below)	50 percent sensitive for significant sites: Native American fishweir site(s)	100 percent sensitive for significant sites: deeply buried Native American fishweir (sites)
				19th c. domestic/commercial structures and associated yard areas			
	Mitigation		*Avoidance of archaeologically sensitive areas or data recovery program in advance of construction activities, to be provided for in a Section 106 Programmatic Agreement for cultural resources.*				
	Historic	None	**Total of 60 NR eligible historic resources,** of which 49 will be affected and 11 will not be affected by the project: Permanent surface elements. **Boylston Station** Piano Row National Register Historic District - Emergency tunnel vents/fresh air vents within district The Little Building (NR Listed) - Proposed entry/egress The Walker Building (contributes to Piano Row historic district) - Emergency egress Boston Common (National Historic Landmark, Local Landmark, within the Boston Common and Boston Common and Public Garden National Register Districts) Emergency egress structure Green Line elevator (2) Green Line second emergency egress (2) **Chinatown Station** The proposed access/emergency egress structure could be within the China Trade Building (NR Listed) or within the Liberty Tree Historic District Liberty Tree Historic District - National Register Historic District - Emergency tunnel vents/fresh air vents within district.	Total of 19 NR eligible historic resources, of which 9 will be affected and 10 will not be affected by the project: The alignment crosses Approximately 80 feet of the Tremont Street Tunnel South Extension (NR eligible) would be demolished. Permanent surface elements.	Total of 18 NR eligible historic resources, of which 12 will be affected and 6 will not be affected by the project: Demolish entire Tremont Street Tunnel South Extension. Permanent surface elements.	Total of 13 NR eligible historic resources, of which 7 will be affected and 6 will not be affected by the project: Demolish the Tremont Street Tunnel South Extension from Stuart Street south – approximately 625 feet of the tunnel. Permanent surface elements.	Total of 27 NR eligible historic resources, of which 20 will be affected and 7 will not be affected by the project: - Could be affected by proximity to the portal (see the Land Use Impacts for a description of uses and the Traffic Impacts for a discussion of some of the potential access impacts): 135 Columbus 139 Columbus 147 Columbus 155 Columbus Permanent surface elements.
	Mitigation		*A process to ensure compatibility of Silver Line elements with the cultural resources in the corridor through design and construction will be provided for in a Section 106 Programmatic Agreement for cultural resources.*				

Table 7.4-1 – Summary Matrix of Long-Term Environmental Impacts and Proposed Mitigation Measures

Environmental Category		Baseline	Core Tunnel Segment	Charles Street/ NEMC Portal	Tremont Street/ NEMC Portal	Stuart Street/ NEMC Portal	Columbus Avenue/Columbus Avenue Portal
Parklands		None	Boston Common (see historic resources)	Elliot Norton Park - Temporary construction impacts.	None	None	None
	Mitigation		*Work with the MHC, Boston Landmarks Commission and Boston Parks and Recreation Department to develop the design of surface elements in Boston Common will seek approval from the Massachusetts Department of Public Safety to allow the use of a pop-up hatch instead to an open stairwell to further reduce visual impacts on the Common.*	*Park will be restored after the construction period.*	*None needed*		
Visual and Aesthetic Environment		None	Emergency egress structure adjacent to Deer Park Maintenance Facility or within a widened sidewalk on the north side of Boylston Street would have a visual impact.	Components of the portal, especially catenary, and parapet walls and protective fencing, could result in visual impacts.			
	Mitigation		*Extensively mitigated through design and use of high quality materials. See also Parklands Mitigation.*	*Mitigated through design and use of high quality materials.*			
Safety and Security		None	No impacts.				
	Mitigation		*Specific safety and security standards, including those required by the Federal Transit Administration, National Fire Prevention Association, Boston Fire Department and Boston Building Department, will be incorporated into tunnel and station design and existing MBTA safety practices and procedures would be implemented to ensure the safety of employees and patrols in stations and on trains.*				
Energy		None	The project represents a reduction in regional vehicle miles of travel which would result in a net benefit effect on energy use in the region.				
	Mitigation		*None needed*				
Secondary and Cumulative Impacts		None	All analysis has assumed future development projects[4] and anticipated population, employment and land use projections[5] over the next two decades. This information indicates that the Silver Line project is needed to support the transportation demands of future development.				
	Mitigation		*None needed*				

[4] Columbus Center, The Clarendon, Hayward Place.

[5] As forecast by the Metropolitan Planning Area Council and the Boston Redevelopment Authority.

7.4.4 Conclusions

The environmental impacts of the Core Tunnel Segment are common to all of the Build Alternatives. The principal impacts, those associated with new structures on the Boston Common and the potential construction period use of a portion of the Common are significantly reduced, compared to the 1993 FEIS/EIR alignment, and they will be fully mitigated.

Among the Build Alternatives, the Tremont Street and Stuart Street Alternatives would involve more significant impacts on traffic and historic resources, arising from the need for cut-and-cover construction along Tremont Street and the demolition of the existing National Register-eligible Tremont Street Subway Tunnel Extension. The Charles Street Alternative would involve significant construction-period impacts on parkland, arising from the cut-and-cover construction that would occupy Elliot Norton Park and require legislative approval under Article 97 of the Massachusetts Constitution. The park would be fully restored after construction. The only significant environmental impacts associated with the Columbus Avenue Alternative, relative to the other three alternatives, would be potential access impacts to properties abutting the portal boat section, and potential groundwater impacts, which are proposed to be minimized and mitigated. Therefore, the Charles Street and Columbus Avenue Alternative would result, on balance, in the lowest level of environmental impacts.

7.5 New Starts Criteria

This section describes the New Starts Criteria and associated evaluation measures that the FTA uses to evaluate and rate transit projects nationwide that are seeking Federal funding for implementation. The New Starts program is the Federal government's primary financial resource for supporting locally-planned, implemented, and operated fixed-guideway transit capital investments. Maintaining eligibility for Federal funding is essential for the Silver Line project's financial feasibility, given the constraints on the MBTA's capital budget.

Each year the FTA prepares its Annual Report on New Starts for Congress as a companion document to the annual budget submitted by the President. The report documents recommendations for the allocation of funds under Section 5309 of Title 49 of the United States Code. The Transportation Efficiency Act for the 21st Century (TEA-21) requires that the Annual Report include the evaluation and rating of new or extended fixed-guideway transit projects. The FTA reviews the criteria results for each candidate project and assigns a rating for each criterion. Based on criteria ratings, a candidate project receives an overall rating of either highly recommended, recommended or not recommended. Silver Line Phase III received an overall recommended rating in FTA's Fiscal Year 2006 Annual Report on New Starts.

Project sponsors are asked to provide the results on specific project measures that respond to each of FTA's New Starts criteria. The measures are derived by comparing the estimated results for the New Start project to those of the Baseline Alternative. For the Silver Line Phase III project, the Baseline Alternative is different from the No-Build because it includes increasing the frequency of service on Silver Line Phases I and II to a level consistent with what would be provided in coordination with the proposed Phase III service.

A comparative summary of the Build Alternatives according to key New Starts evaluation criteria is shown in Table 7.5-1.

Table 7.5-1 – Summary of New Starts Criteria

Alternative	Daily Ridership	Annual Ridership	User Benefit[1]	Cost-Effectiveness	Mobility Improvements	
	Trips	Trips	Hours	Dollars per hour of travel time savings	Low Income Households within 1/2 mile of stations	Jobs within ½ mile of stations
Tremont Street	160,228	47,267,260	5,449,830	$16.72 (Medium)	4,077	187,154
Charles Street	160,228	47,267,260	5,449,830	$15.96 (Medium)	4,077	187,154
Stuart Street	160,228	47,267,260	5,449,830	$16.79 (Medium	4,077	187,154
Columbus Avenue	153,940	45,412,300	5,487,295	$15.07 (Medium)	5,118	217,200

Source: CTPS
Note: 1. User Benefit is measured in hours of transportation user benefit per year as calculated by SUMMIT, a travel demand forecasting software created by the FTA and required by Congress to be used on all New Starts projects.

7.6 Summary

All four of the Build Alternatives satisfy the project's purpose and need; the No-Build and Baseline Alternatives do not. Although all of the Build Alternatives meet BRT performance characteristics, the Charles Street and the Columbus Avenue Alternatives best meet these characteristics. The Columbus Avenue Alternative would result, on balance, in the lowest level of long-term and short term (construction period) environmental impacts. Finally, all four of the Build Alternatives satisfy the project standards of the FTA's New Starts program.

This document uses a uniform service plan to test the four alternatives in order to provide an "apples to apples" comparison. Once a locally preferred alternative is chosen, the Supplemental Final EIS will explore a series of options with the intent of fine-tuning the alternative to reduce capital and/or operating costs as well as increase ridership and user benefits so as to optimize the project to make it as cost effective as possible.

For example, this project, like all other MBTA projects will go through a series of value engineering experiences that will look at ways to reduce capital costs or risk in construction. Concepts under consideration for value engineering will include, but not be limited to, examination of emerging bus propulsion technology which may enter the market place over the next few years at substantially lower capital cost. Additionally, while a mid block station (that is, one station serving both Boylston and Chinatown) has been examined, there may be options that do not have the critical design and operational flaws as the one previously examined. The MBTA will be examining the possibility of using a mid-block station but in a different location in the alignment so as to not have the grade considerations that the former proposal had.

Additionally, as the project progresses, the MBTA will examine surface route plans and adjust them over time to conform to changes in land use, new major developments, new traffic considerations, or ways to maximize operational benefits. The surface routes identified in this environmental document are the best available route options at this time, and are laid out for the purpose of performing environmental analysis. They are not to be considered the final or binding route plan. The MBTA will continue to examine these routes and make changes as appropriate.

Changes made in either of these two programs (value engineering or route planning) are not likely to result in significant environmental impacts, if any impacts at all. The MBTA believes that only those changes that have the potential to significantly impact the environment over and above what was presented in the environmental documents should be subject to additional review. Any minor changes, or changes that do not have environmental consequences, should not warrant additional review.

CHAPTER 8.0 PUBLIC INVOLVEMENT

8.1 Public Involvement

Under the Silver Line Phase III Public Involvement Program, the Massachusetts Bay Transportation Authority (MBTA) has established the Silver Line Communications and Community Development Office (SLCO) and developed, implemented, and managed a broad-based and comprehensive program of public participation with area residents; businesses; civic and environmental organizations; and government agencies. This chapter describes those efforts which have been ongoing since January 2003, as well as future efforts in support of selection and implementation of the preferred Phase III alternative[1].

During the time frame between January 2003 and April 2005, the MBTA has conducted and coordinated a diverse public involvement program to disseminate information to key stakeholders, and seek input on the Phase III alternatives from members of the impacted communities. This process has included more than 130 meetings with key city representatives, community, business, civic, and institutional groups in the neighborhoods along the alignment study areas, as well as more than 40 meetings, briefings and discussions with elected officials.

Moreover, the MBTA's *3rd Annual Update Pursuant to M.G.L. Section 61 o*n the Silver Line project, which presented and assessed alternatives for the Phase III segment, was broadly circulated among community stakeholders to ensure that representatives of neighborhoods along the potential Phase III alignments had sufficient opportunity to review and provide comments on the Report. Over 200 letters, with comments primarily related to the Phase III alternatives, were submitted on that document.

The scoping process for this Supplemental Draft Environmental Statement/ Environmental Impact Report (SDEIS/EIR) began in June 2004 with the submission of the Notice of Project Change (NPC) to the Executive Office of Environmental Affairs (EOEA), and the publication of notice in that office's *Environmental Monitor*. The MBTA held a Public Hearing in July 2004 at the Renaissance Charter School, located in the heart of the Phase III corridor, to solicit comments on the scope of the SDEIS/EIR. The Public Hearing was attended by an estimated 75 members of the public, including representatives of key business, civic, and institutional groups who provided public testimony concerning the project's alternative alignments.

On the basis of the MBTA's commitment to facilitate the broadest possible level of public comment on the NPC, the agency requested an EOEA extension of the public comment period from the required 20-day time frame to a 37-day time frame. During this period, more than 100 comment letters were submitted to the EOEA. These letters have been used by the MBTA to further develop and evaluate the alternatives for the Silver Line Phase III service.

The public involvement strategy for Silver Line Phase III ensures that members of the public are afforded all opportunities to have the most up-to-date information and provide the level of feedback that is a critical component of the alternatives analysis process. To that end, the MBTA has scheduled a substantial number of meetings directly with key stakeholder groups in order to be fully informed of the issues and concerns that are unique to particular neighborhoods that are likely to be impacted by the four alternative alignments presented in this SDEIS/EIR.

[1] The public involvement process for the project has been ongoing for over two decades, beginning with the predecessor Transitway project which received its federal and state environmental approvals in 1994. For the Silver Line Phase III specifically, additional examination of alternatives was begun in 2001, including an assessment of potential alignment alternatives presented in the *3rd Annual Update* (see Chapter 2 for a summary of the project's history). This chapter describes the public process since the development of reliminary Phase III alternatives.

In addition, throughout the public involvement process, the MBTA continues to remain accessible to any stakeholders who have follow-up questions and concerns. In those instances where the most beneficial course of action is to schedule follow-up meetings, the MBTA has held as many as three meetings with specific stakeholder groups. Such follow up has helped inform the level of analysis associated with each Phase III alternative.

More details about the Phase III public involvement program, its participants, and their roles and activities are provided below.

8.2 Public Outreach Activities

The primary public involvement activities associated with the Silver Line Phase III project include:

- Creation and maintenance of a mailing list comprised of over 40 neighborhood-based residential, business and civic groups, representing over 300 concerned citizens who live and/or work along the Phase III corridor, along with participants and interested individuals to ensure the broadest possible level of outreach.

- Sponsorship or participation in more than 130 public, community, and agency meetings, as well as briefings with elected officials between January 2003 and April 2005.

- The Silver Line project web site http://www.allaboutsilverline@mbta.com, which provides general information on all phases of the Silver Line, including Phase III. Additionally, the SDEIS/EIR and Annual Updates are made available to the public via this web site.

- Involvement with more than 200 participants and meeting attendees between January 2003 and April 2005.

- Publication of four Annual Updates (2000 through 2005) and the June 2004 NPC, each of which has been circulated to the full mailing list described above.

- Receipt of more than 350 written and oral comments from members of the public, elected officials, and agency representatives concerning the proposed Silver Line Phase III alternatives.

Since the inception of Silver Line Phase III, the MBTA has established and defined the responsibilities and relationships among the participants. In addition to the MBTA and its consultant team, the principal participants include:

- Stakeholders, comprised of residential neighborhood groups, healthcare and academic institutions, civic associations, cultural and social groups, and individuals who have an interest in the project;
- Federal, state, and municipal agency representatives;
- Local elected officials; and
- Business and business associations throughout the city.

8.2.1 Stakeholder Group Meetings

One-on-one meetings with key stakeholder groups have been the primary forum for project discussions. These groups include residential, business and institutional abutters who will be impacted by Silver Line Phase III construction activities and/or service operations, and civic groups who have an interest in environmental and other key project impacts. Additionally, individuals who are public transit advocates or have other related interests have also participated in the MBTA's Silver Line Phase III public involvement activities.

Meetings have been held with such diverse groups as the Bay Village Neighborhood Association, the Chinatown Neighborhood Council and the Park Plaza Community Advisory Committee. In those instances where the dialogue is ongoing, additional follow-up meetings have been scheduled with key groups.

- During the time period of January 2003 to April 2005, an estimated 130 meetings have been held with key stakeholder groups, as shown in Table 8.2-1.

- The scope of presentations included a range of topics, including project purpose and need; overviews of each alignment concept; economic and employment benefits; user benefits and transportation improvements; project environmental justice goals; the environmental review process; and next steps.

- Key stakeholder comments include public safety; traffic; environmental impacts, with specific focus on historic homes, parks, groundwater; and construction impacts. Additional comments focused on business/financial impacts and clarification of the public process also have been provided.

- The MBTA has used the feedback obtained from the stakeholder meetings to improve the Phase III alternatives and to strengthen the criteria applied to evaluate alternatives.

Table 8-2.1: Stakeholder Meetings

LOCATION	DATE
Neighborhood Community Groups	
Worcester Square Neighborhood Association	January 6, 2003
South Boston Waterfront Transit Committee	January 7, 2003
Dudley Square Main Streets	January 8, 2003
South Boston Waterfront Transit Committee	January 9, 2003
Chinatown YMCA and YMCA of Greater Boston	January 21, 2003
Worcester Square/South End Health Center	May 5, 2003
Chinatown Neighborhood Council/St. James the Greater Church	May 15, 2003
Chinese Progressive Association	June 2, 2003
Chinatown Coalition	June 11, 2003
South Boston Waterfront Transit Committee	June 12, 2003
Chinatown YMCA and YMCA of Greater Boston	June 25, 2003
Josiah Quincy School	June 27, 2003
Washington Main Streets Neck Ties Event	June 24, 2003
Madison Park Community Development Corporation	August 8, 2003
South Boston Waterfront Transit Committee	September 9, 2003
Washington Gateway Main Streets "Meet & Greet"	October 20, 2003
Bay Village Neighborhood Association	November 3, 2003
Bay Village Neighborhood Association Tour	December 5, 2003
Bay Village Neighborhood Association	December 16, 2003
Bay Village Neighborhood Association	January 6, 2004
Bay Village Neighborhood Association	January 9, 2004
Leather District Neighborhood Association	January 14, 2004
Chinatown Coalition	January 14, 2004
Chinatown Neighborhood Council	January 20, 2004
Bay Village Neighborhood Association	February 3, 2004
Chiildren's Services of Roxbury	February 23, 2004
Bay Village Neighborhood Association	February 27, 2004
Josiah Quincy Upper & Lower Schools	March 2, 2004
Chinatown Safety Sub-Committee	April 7, 2004
Boston Connects	April 9, 2004
Zion Fire Baptized Holiness Church	April 22, 2004
South Boston Waterfront Transit Committee	April 26, 2004
Washington Street Corridor	May 21, 2004
Chinatown Informational Meeting "Notice of Project Change" (NPC)	July 12, 2004
Notice of Project Change (NPC) Public Hearing	July 14, 2004
Cape Verdean Community UNIDO	August 17, 2004
Friends of Fort Point Channel	August 24, 2004
Chinatown Coalition Meeting	September 15, 2004
Chinatown Neighborhood Council	September 20, 2004
Chinatown Safety Sub-Committee	October 5, 2004

LOCATION	DATE
Chinatown Residents' Association Meeting	October 6, 2004
SAMPAN	October 7, 2004
Chinese Consolidated Benevolent Association	October 12, 2004
Parcel 23D Meeting	October 21, 1004
Chinatown Safety Sub-Committee	November 3, 2004
Boston Chinese Evangelical Church	November 17, 2004
Ellis Neighborhood Association - Development Committee Representative	November 22, 2004
Chinese Progressive Association	November 23, 2004
Asian American Civic Association	November 23, 2004
Chinatown Residents Association Meeting	December 1, 2004
Chinese Merchants Association	December 6, 2004
Chinatown Coalition	December 9, 2004
Bay Village Neighborhood Association	December 14, 2004
Josiah Quincy Upper School	December 20, 2004
Chinatown Neighborhood Council	December 20, 2004
Boston Fire Department	January 1, 2005
Washington Gateway Main Street	January 4, 2005
Groundwater Trust	January 10, 2005
Chinese Consolidated Benevolent Association/Staff Meeting	January 10, 2005
Chinatown Main Street	January 12, 2005
Neighborhood Association of Back Bay	January 13, 2005
Chinese Residents' Association	January 19, 2005
Ellis South End Neighborhood Association	January 25, 2005
Dudley Main Streets	January 27, 2005
Chinese Consolidated Benevolent Association	February 1, 2005
Boston Chinese Evangelical Church	February 15, 2005
Chinese Radio Program at WJDA	February 27, 2005
Boston Chinese Neighborhood Center	March 4, 2005
Washington Gateway Main Street	March 21, 2005
Urban League of Massachusetts	March 25, 2005
Church of Our Saving Grace	February 27, 2005
Josiah Elementary Quincy School	April 13, 2005
Asian American Civic Association	April 13, 2005
Chinatown Main Street	April 13, 2005
Businesses & Business Associations	
Greater Boston Chamber of Commerce Transportation Committee	February 18, 2003
SAMPAN Interview	March 31, 2003
Doubletree Hotel	April 1, 2003
Move Mass	April 4, 2003
Doubletree Hotel	April 27, 2003
New England Medical Center	May 6, 2003
Greater Boston Chamber of Commerce Transportation Committee	May 19, 2003
Greater Boston Chamber of Commerce Transportation Committee	May 20, 2003
Artery Business Committee	June 25, 2003
Doubletree Hotel	June 27, 2003
Downtown Crossing Association	August 5, 2003
New England Medical Center	August 6, 2003
Greater Boston Chamber of Commerce	August 6, 2003
Wilbur and Shubert Theatres	August 13, 2003
Hyatt Regency Boston	August 13, 2003
Doubletree Hotel/Corcoran & Jennison	August 14, 2003
Midtown Park Plaza Neighborhood Association	September 17, 2003
Rose Associates, Inc.	September 25, 2003
Roxbury Community College "Meet & Greet"	October 15, 2003
Park Plaza Civic Advisory Committee	October 28, 2003
New England Medical Center	November 19, 2003
Mid-Town Park Plaza Neighborhood Association	January 8, 2004
Wilbur Theatre	February 4, 2004
New England School of Law	February 6, 2004
Downtown Crossing Association	February 6, 2004
Milner Hotel	February 11, 2004
Church of all Nations	February 26, 2004
Radisson Hotel	February 27, 2004
Boston Urban League	April 12, 2004
Greater Boston Chamber of Commerce conference call	April 13, 2004
Dudley Church/Pastor Davidson	April 22, 2004
New England Medical Center/Doubletree Hotel	May 6, 2004
New England Medical Center/Joint Venture Team	May 12, 2004
New England Medical Center/Executive Office of Transportation	May 27, 2004

LOCATION	DATE
Emerson College	June 14, 2004
New England Medical Center/Doubletree Hotel	June 19, 2004
Morgan Memorial Goodwill Industries	July 7, 2004
Chinatown Business Association	July 7, 2004
New England Medical Center/Vibration Specialist	October 1, 2004
Greater Boston Chamber of Commerce	November 3, 2004
Back Bay Association	November 9, 2004
New England Medical Center/Doubletree Hotel	November 10, 2004
Downtown Crossing Association Breakfast	November 18, 2004
Washington Gateway	January 4, 2005
Groundwater Trust	January 10, 2005
Winn Development	January 13, 2005
New England Medical Center	January 13, 2005
Ellis Neighborhood Association	January 25, 2005
Dudley Main Streets	January 27, 2005
Chinese Consolidated Benevolent Association	February 1, 2005
Back Bay Business Association/Convention Center	February 11, 2005
Boston Chinese Evangelical Church	February 15, 2005
Benjamin Franklin Smith Printing	February 16, 2005
Back Bay Association	February 11, 2005
New England Medical Center	February 11, 2005
Benjamin Franklin Smith Printing Co.	February 16, 2005
Ellis Memorial Daycare	March 31, 2005
Emerson College	April 4, 2005
Salvation Army	April 7, 2005
Glanz Properties, Inc.	April 12, 2005
Seaport TMA	April 15, 2005
Advanced Electronics	April 20, 2005
WTS Luncheon Presentation	April 21, 2005
Liberty Mutual	April 25, 2005

8.2.2 Interagency Coordination

At the outset of the Silver Line project, the MBTA established a forum for receiving ongoing feedback from federal and state resource agencies as well as City of Boston agencies, and resolving key issues and concerns voiced by these agencies. Over the past 27 months, the MBTA has held more than 12 interagency meetings with city representatives concerning Silver Line Phase III as identified in Table 8.2-2. The MBTA's role and responsibility with key agencies is as follows:

- Federal Agency Coordination – The MBTA is holding frequent meetings with the Federal Transit Administration (FTA) that provide opportunities for the MBTA to share the most up-to-date information about the Phase III alternatives.

- State Agency Coordination – The MBTA has worked with the EOEA since the inception of the Silver Line project. All aspects of the public involvement process have been conducted in accordance with applicable EOEA requirements.

- Municipal Agency Coordination – Regularly scheduled meetings have been held with representatives of the Boston Redevelopment Authority (BRA), Boston Transportation Department (BTD), Boston Parks and Recreation Department (BP&RD), and the Boston Environment Department to obtain technical feedback on the Silver Line Phase III alternatives and associated environmental and construction impacts; as well as anticipated community reactions to specific alignment impacts prior to presenting any scenarios to members of the community.

- Interagency Meetings - The MBTA has held a number of interagency meetings with state and municipal agencies related to the public involvement process and key environmental issues, in particular archeological and historic resources, parks and traffic. These meetings have

included the Massachusetts Historical Commission (MHC), the Boston Landmarks Commission (BLC), BP&RD, and BTD.

Table 8.2-2: Federal, State, and Municipal Agency Meetings

Agency	Date
Federal Agencies	
Federal Transit Administration Update Meeting	January 18, 2005 January 28, 2005 February 15, 2005
State Agencies	
Central Transportation Planning Staff Meeting	January 22, 2003
MassHousing Meeting	July 16, 2003
Resource Agencies	November 20, 2003
Resource Agencies	February 2, 2004
Massachusetts Port Authority Stakeholders Meeting	March 10, 2004
Resource Agencies	May 13, 2004
City Agencies	
Boston Landmark Commission Hearing	January 6, 2003
Boston Transportation Department	March 20, 2003
Boston Redevelopment Authority	May 12, 2003
City of Boston Department of Neighborhood Development	June 10, 2003
Mayor's Office of Neighborhood Services	June 19, 2003
Inter-agency Silver Line: City/MBTA	August 4, 2003
Boston Redevelopment Authority	August 4, 2003
Boston Transportation Department	September 23, 2004
Boston Redevelopment Authority	October 27, 2003
Inter-agency Silver Line: City/MBTA	October 28, 2003
Mayor's Office of Neighborhood Services	November 17, 2003
Boston Transportation Department	February 2, 2004
Inter-agency Silver Line: City/MBTA	July 1, 2004
Boston Redevelopment Authority	July 8, 2004
Resource Agencies	July 8, 2004
City of Boston Department of Neighborhood Development	July 9, 2004
Boston Redevelopment Authority	August 6, 2004
Waterfront Silver Line Stakeholders Mtg/Courthouse	October 20, 2004
Inter-agency Silver Line: City/MBTA	October 25, 2004
Boston Transportation Department/Boston Redevelopment Authority	December 21, 2004
Boston Fire Department	January 18, 2005
Boston Transportation Department Update Meeting	February 2, 2005
Boston Fire Department & Building Inspector	February 10, 2005
Boston Parks and Recreation Department	February 11, 2005
Boston Redevelopment Authority	February 14, 2005
Mayor's Office of Neighborhood Serviices	March 3, 2005
Boston Transportation Department	March 18, 2005

8.2.3 Briefings with Elected Officials

Local elected officials have closely monitored the issues and concerns raised by stakeholders during meetings and in any follow-up discussions regarding the analysis of Silver Line Phase III alternatives. During the period between January 2003 and April 2005, the MBTA has scheduled in excess of 40 meetings, briefings, and discussions with local elected officials, as summarized in Table 8.2-3. This dialogue will continue throughout the course of the planning, design and construction process.

Table 8-2.3: Elected Officials Briefings

Elected Officials
Congressman Michael E. Capuano
Congressman Stephen F. Lynch
State Senator Steven A. Baddour
State Senator Salvatore F. DiMasi
State Senator John A. Hart
State Senator Dianne Wilkerson
State Rep Paul Demakis
State Rep Gloria L. Fox
State Rep Byron Rushing
State Rep Marie St. Fleur
State Rep Marty Walz
Massachusetts Black Legislative Caucus
City Councilor Michael F. Flaherty
City Councilor James M. Kelly
City Councilor Michael P. Ross
City Councilor Paul J. Scapicchio
City Councilor Chuck Turner
City Councilor Charles C Yancey

8.2.4 Environmental Justice

As described in Section 4.3, the MBTA has considered environmental justice issues that may affect the project, in accordance with Executive Order 12898 and related policy documents developed by federal, state and regional agencies. Identification of the environmental justice communities potentially affected by the Phase III alternatives is provided in Section 4.3. An analysis of environmental justice impacts and benefits is provided in Section 5.7. A fundamental principle of environmental justice is ensuring the full and fair participation in project planning, development, and decision making by all potentially affected communities, particularly those with minority and low-income populations. To further support these efforts, the public participation program has been designed to meet the needs of non-English-speaking residents in the Phase III corridor. For the Tremont/Stuart/Charles Street Alternatives, about 17 percent of the population is classified as non-English speaking; 12.4 percent of the total population within half-mile of the Columbus Avenue Alternative is similarly classified. In each case, the dominant alternative language is Chinese. To achieve these goals, the public involvement program for the Silver Line Phase III project has featured the following:

- Meetings have been held at convenient times and places to support the constraints of worker schedules; families with childcare needs; and senior citizens with limited physical mobility and health challenges. For example, the public hearing for scoping the SDEIS/EIR was held at 7:00 p.m. on a weekday evening at a public school located adjacent to the Chinatown, Bay Village and South End neighborhoods.

- Outreach activities, as described in Section 8.2.1, have included stakeholder meetings with religious and civic organizations; minority business associations and cultural associations and other community groups, to ensure that complete information is provided to and feedback obtained from the full diversity of the constituencies and neighborhoods along the Silver Line Phase III corridor.

- Designation of a liaison person as a source of contact for the Chinatown community.

- Language translations and listening devices have been provided at meetings so that individuals who face language barriers or hearing challenges are able to understand the scope and substance of project-related discussions. Interpreters are provided at meetings for those who speak different languages or different dialects within a particular language. At the public hearing for scoping the SDEIS/EIR, both language translations and listening devices were available for residents of the Chinatown community.

- Written translations that have been provided to the Chinatown community include meeting notices, meeting attendance sheets, agendas, text of Power Point presentations, and the Executive Summary of both the June 2004 Notice of Project Change and this SDEIS/EIR.

- Additional information has been provided to the Chinatown community through the print media with the SAMPAN and World Journal Chinese Daily, and with a local Chinese radio show.

- Future translation plans include project fact sheets, project/construction progress reports and public notices to keep the Chinatown community fully informed.

- The Silver Line DIG IT newsletter, described in Section 8.4 below, is broadly disseminated to the public on a quarterly basis through direct mailings and as part of handouts at neighborhood community meetings.

8.3 Coordination with Affected Businesses and Residents

Once a preferred alternative is selected and construction methodologies and staging areas are identified, the MBTA will complete its process, already begun, of identifying all residents and area businesses that will be affected by construction, including minority and women-owned businesses. This will ensure that the appropriate mitigation strategies can be in place well before construction of Phase III gets underway. As noted in Section 5.2, there are no residential displacements as a result of any of the Phase III alternatives under evaluation. However, there will be impacts to businesses, which will vary by alignment and portal alternative.

Cut-and-cover and construction staging areas will create some street-level impacts and disruptions for area residents and businesses. (See Chapter 6.0 for a more detailed discussion of construction period impacts and mitigation.) The SLCO will continue to coordinate the community participation process. For residents in the vicinity of Phase III work areas, the MBTA will establish a Phase III liaison position within the MBTA. This liaison will coordinate with residential communities on plans for Silver Line construction, including construction techniques, schedules, and anticipated impacts. A liaison will also be available to respond to community concerns both before and during construction activities.

Further strategies will be put in place to support area businesses before and during construction. The MBTA plans to develop a mitigation package to minimize serious financial impacts and logistical disruptions impacting the operations of these businesses. Potential strategies under consideration include:

- Meeting with businesses once construction staging areas are selected to determine their access needs and integrating these requirements into the Construction Management and Traffic Management Plans.

- Developing Management and Traffic Management Plans and determining compliance measures in cooperation with local residents and businesses.

- The liaison will also be the primary source of contact for impacted businesses throughout the construction process.

- Providing an information package to each business owner with pertinent information, names and contact of construction representatives and utility companies to contact in case of an emergency.

- Using a proactive strategy of building and maintaining ongoing dialogue with impacted businesses through the liaison so that issues are addressed in a time-sensitive manner.

8.4 Collateral Materials Produced and Distributed

The MBTA has prepared a wide variety of informational material for dissemination at community meetings, and briefings with elected officials, business, institutional and civic groups to keep all stakeholders informed and to maintain a consistent flow of two-way communications. A summary of outreach tools that are currently in use for Silver Line Phase III and additional materials that are being developed for future use is provided as part of this section.

Current outreach tools include:

- **Allaboutsilverline.com** - The MBTA's Silver Line web page provides the public with project status reports and other pertinent information, as well as an opportunity for members of the public to provide comments directly to the MBTA.

- **Power Point Presentations** - Numerous Power Point presentations have been prepared, with the benefit of customizing presentations to present technical project and alignment information while highlighting specific questions and concerns unique to a particular stakeholder group.

- **Presentation Boards/Graphics** - Presentation boards and project graphics are used to help stakeholder groups and individuals better understand and visualize technical and design elements of the project and focus on key alignment areas through the use of maps.

- **Informational Mailings** - Project updates and meetings notices are disseminated to the broader community of stakeholders at key project milestones, through utilization of the comprehensive Silver Line stakeholder mailing list.

- **DIG IT Newsletter** -The MBTA issues the DIG IT newsletter on a quarterly basis to facilitate a broader level of public awareness about the overall project facts, as well as to provide updates concerning the current SDEIS/EIR process and schedule.

Future outreach tools include:

- **Brochures and General Information Sheets -** Silver Line Phase III Brochures and General Information Sheets are being prepared as another outreach tool that will be used to highlight the benefits of the project and maintain the flow of information between the MBTA and stakeholders.

- **Interactive computer presentations and simulations** - This concept is currently under evaluation as a possible addition to the Silver Line web site to further educate the broader community about the technical aspects of the project.

- **Video** - A short project video can be a very useful educational and informational that can supplement other materials and information that is provided to the community.

- **Media strategies** - A strategic, proactive media plan is in preparation in an effort to continue to educate and inform the community in the most positive manner possible.

- **Other Outreach Tools Under Consideration** - Other outreach tools that may be introduced after further evaluation include a Volunteer Riders Committee to provide feedback concerning service and operations; informational kiosks that would be placed at strategic locations along the Silver Line alignment; and, the creation of a Hot Line that will be useful to stakeholders during the construction process. Informational materials will also be available at the SLCO, at libraries, and other strategic locations along the selected Silver Line Phase III route.

8.5 Public Comments on Silver Line Phase III

The MBTA's Silver Line Phase III project has generated hundreds of comments in a variety of meetings, telephone calls, correspondence, and via the web site. A number of comments express concerns about potential environmental and construction impacts, especially as it relates to historic properties; open space and groundwater.

The MBTA continues to review and evaluate all comments with a commitment to bring resolution to as many of these issues as possible, using a number of forums. Response to comments on the June 2004 Notice of Project Change are provided in Volume II of this SDEIS/EIR.

An extended comment period on this SDEIS/EIR will be provided to provide an opportunity for all those wishing to comment to do so. In addition, a Public Hearing on the SDEIS/SDEIR will be held during the public comment period.

8.6 Next Steps

As the Silver Line Phase III project continues to advance, a key component of the MBTA's public outreach strategy will involve strengthening current activities and further targeting them to specific groups of stakeholders. A major objective of this strategy is to create the broadest possible level of participation while also seeking to maximize diversity of participants as it relates to ethnicity, income and the physically disabled. The broader voices of a diverse group will help the MBTA to build a system that meets the needs of the core users. Key ideas under consideration include the following:

Silver Line Working Group

- Establish a Silver Line Working Group to work with the MBTA in an advisory capacity around key issues such as urban design plans, service and operations, such as scheduling and logistics, and mitigation of construction impacts on residents and businesses along the Silver Line Phase III Corridor. The Working Group would be a useful forum for disseminating project updates to the members of their organizations.

- The Working Group would include representatives of key stakeholders, public agencies and elected officials, who will be most impacted by the Silver Line Phase III. A maximum of fourteen members is under consideration as the optimum number of people to most effectively carry out the tasks of the Working Group.

- Several key benefits of establishing the Working Group include creating opportunities for a representative group of all stakeholders to work together with the MBTA to share ideas in one forum that will help to build broad public support for project design and service/operations.

Coordination with Impacted Residents and Businesses during Construction

A proactive strategy will be used that seeks to minimize any disruptions to residents and business operations and the resulting financial impacts on these businesses. A multi-tiered plan will be implemented to provide the best possible experience for each impacted residential community and business. This plan will include working with the City Agencies and key stakeholders to prepare comprehensive Construction Management and Traffic Management Plans; meeting with affected residents and businesses in advance of construction to discuss the likely impacts and to obtain feedback and respond to questions and concerns generated by the impacted parties; and providing access to a construction liaison to respond to questions and concerns.

CHAPTER 9.0 FINANCIAL ANALYSIS

9.1 Introduction

The MBTA has analyzed the financial feasibility of the Phase III Build Alternatives. This analysis, which has been conducted in accordance with Federal Transit Administration (FTA) guidance for transit financial plans, assesses the capacity of the Authority to construct and operate the project, while ensuring continued operation of its existing system and implementation of other planned expansion projects. As a worst case scenario, this analysis has been performed for the most expensive of the four alternatives – the Tremont Street Alternative. If this alternative is financially feasible, then the less expensive alternatives will also be feasible.

This chapter describes the sources of funds that would be used to implement Phase III of the Silver Line, presents the financial analysis approach, and summarizes findings regarding the financial feasibility of the Phase III Build Alternatives.

9.2 Sources of Funds

9.2.1 Operating

Fiscal reform legislation (Forward Funding) transitioned the Authority's funding environment nearly five years ago. The new enabling act established dedicated sources of revenue and mandated the Authority to operate as an independent financially self-sustaining public transportation agency. Prior to Forward Funding, the Commonwealth funded the Massachusetts Bay Transportation Authority (MBTA) in arrears. The Enabling Act and the new financing mechanism for the MBTA have been referred to as "Forward Funding" to reflect the fact that the MBTA's costs will no longer be funded in arrears.

Commencing July 1, 2000, the Authority no longer received Net Cost of Service or debt assistance. Instead, under the Enabling Act, the Authority receives a dedicated revenue stream consisting of assessments paid by the 175 cities and towns in accordance with the Enabling Act (Assessments) and the greater of the amount raised by a one percent statewide sales tax, which equals 20 percent of the existing statewide five percent sales tax, or $645,000,000, in either case to be funded from existing sales tax receipts, subject to upward adjustment under certain circumstances set forth in the Enabling Act (Dedicated Sales Tax and, together with the Assessments, Dedicated Revenues). In addition to the Dedicated Revenues, the Authority's operations are funded by fare revenue and non-fare revenue (such as revenue from advertising, parking, concessions, real estate sales, and interest income).

9.2.2 Capital

The MBTA's capital program is primarily funded by two major sources: revenue bonds and Federal grants, including FTA Section 5309 New Starts discretionary grant program for which the Phase III project is eligible. Prior to Forward Funding, the MBTA's non-Federal portion of the capital program was funded by General Transportation System bonds issued by the MBTA and backed by the Commonwealth Guaranty. Under Forward Funding, the MBTA's non-Federal portion of the capital program is primarily funded in the early years by revenue bonds secured by the Dedicated Revenues under two separate credits (Assessment bonds and Sales Tax bonds)

established under the Enabling Act. The Assessment bonds are secured by the Assessments paid by the 175 cities and towns in the MBTA district and the Sales Tax bonds are secured by the Sales Tax Revenues received by the Authority. The MBTA Sales Tax and Assessment credits are further enhanced by a cross collateralization that exists for additional security.

The MBTA's goal is to preserve sufficient funding for the operating budget and to not allow debt service expenses to increase in relation to operating expenses. Taking this into consideration, the MBTA is working to transition from a large reliance on debt financing to greater use of pay-as-you-go financing for capital projects.

9.3 Analysis Approach

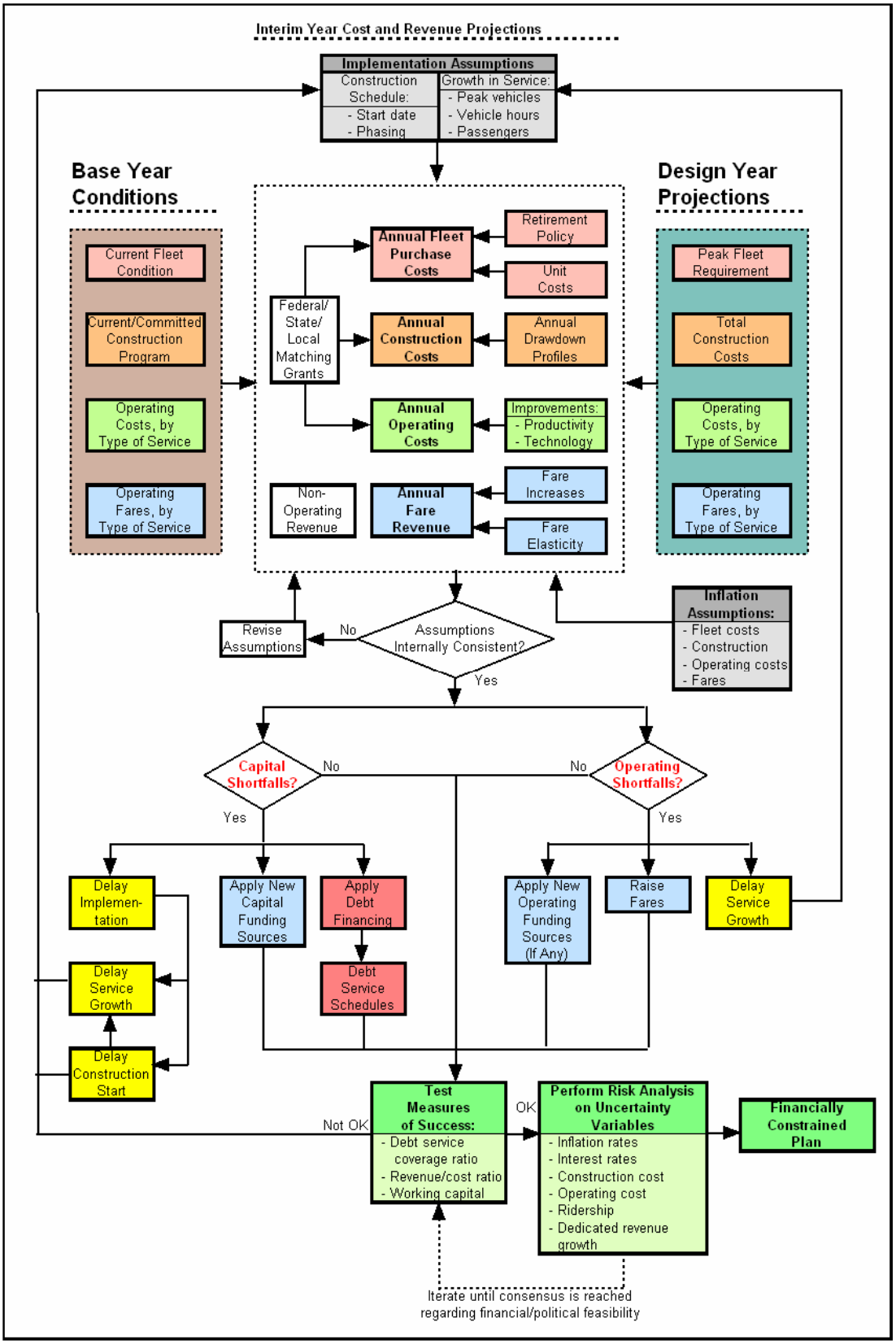
Figure 9.3-1 summarizes the process used for financial analysis of Phase III alternatives. As shown, this process emphasizes a comprehensive approach to the integration of sources and uses of funds. A project will not be considered financially feasible until it can be demonstrated as fundable within the MBTA's financially constrained plan.

The following three major components served as the basis for the analysis:

- Construction Program. Annual costs for the transit facilities construction program which include:
  - Capital expansion projects
  - The remainder of the Capital Investment Program, which includes rehabilitation
  - Buses and rail car fleets.
  - Operating Costs. Incremental operating and maintenance costs associated with Silver Line Phase III, the existing system, and other planned system expansion projects.
  - Operating Revenues. Growth in fare revenue based on growth in service and travel demand forecasts for transit region-wide.

    A sources and uses of funds analysis was then undertaken and the year-end balance was reviewed to determine the sufficiency of capital and operating funds to implement the Phase III project. This analysis was performed for the most expensive of the Phase III Build Alternatives, and assumes that the MBTA will receive Federal New Starts funding equivalent to 60 percent of Phase III project costs.

Figure 9.3-1 Components of Sources and Uses of Funds Analysis



9.4 Summary

The financial analysis was structured to support three basic funding strategies:

First, fund the operating program: MBTA's basic objective is to provide quality transit services to all its customers. After paying off debt service associated with revenue bonds, the dedicated revenues assumed in the analysis are applied to operations with any remaining balances applied to capital expenses.

Second, fund the Capital Investment Program, including rehabilitation and replacement as well as new initiatives: MBTA's priority capital investment must be to preserve the existing infrastructure and to improve customer service and convenience on existing service.

Third, fund the construction of the Silver Line Phase III: The proposed capital program entails significant capital costs which MBTA can finance through a combination of pay-as-you-go and short- and long-term financing.

The financial analysis has demonstrated that these three funding strategies can be achieved, and all four Build Alternatives are financially feasible. Further, the analysis was reviewed in detail by FTA in the fall of 2004. FTA's review looked at three key issues:

1. Proposed non-Section 5309 New Starts share of project costs;

2. Stability and reliability of capital finance plan; and

3. Stability and reliability of operating finance plan.

Based on this review, the FTA determined that the MBTA has demonstrated sufficient financial capacity to undertake the Phase III project. The MBTA's financial analysis will be updated once the preferred alternative for Phase III is selected.

Given that all Phase III alternatives are feasible, there are no differences related to funding and finance among the alternatives.